Project #94.3.2.3

Durham Coastal Method Inventory and Evaluation Project

June 1995

Information and Recommendations
for the Management of
Vegetated Tidal Marshes

Durham Coastal Method Inventory and Evaluation Project

Estuarine Meadow Marsh
Johnsons Creek in Durham

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This study was primarily funded by the Coastal Program at the Office of State Planning.

Richard Cook, Director of Wetlands and Wildlife, Audubon Society of New Hampshire, provided the necessary training and expert assistance throughout the project.

William B. Bowden, Professor at the University of New Hampshire, gave Wetlands Resource Management students the opportunity to volunteer their time to the Coastal project as a class assignment. Twenty-two students participated in the project by volunteering their time in training, office and field work.

The New Hampshire Department of Fish and Game and the New Hampshire Natural Heritage Inventory provided information regarding threatened and endangered species, public water access points, recreational harvest areas and historical points of interest.

The cooperative nature of this project made a lot of people aware of the predicament of tidal marshes and the purpose of the Durham Coastal Method project. This study will lead to the protection of tidal marshes in the Town of Durham and will serve as an example for other coastal communities to follow.

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REPORT FORMAT

This report contains a description of the methodology and the results of the data collection for the Durham Coastal Method project. The results are displayed in various formats, by summary tables, by marsh function, by marsh system and evaluation unit, and by the Coastal Method options matrix.

Management recommendations are presented for individual Marsh Systems and Evaluation Units. These recommendations are based on (1) Noteworthiness of the area; (2) Recreation and Education Potential of the area; (3) Hazards to the area; and (4) Protection and Restoration recommendations.

An annotated bibliography at the back of this text describes resources which may have been used in this study and which will help the Town with subsequent research efforts (these documents are available through SRPC).

PURPOSE

The Town of Durham has recognized the need to protect their shorelands. It is a goal statement in the Durham's 1989 Master Plan, "to protect environmentally sensitive areas in the Town, including watersheds, aquifers, coastal shorelines, floodplains and stream banks". The inventory and evaluation of salt marshes in Durham is one of the objective to accomplishing that goal.

This project was initiated by the Town in order to provide information on the functions or "values" of tidal marshes to the Conservation Commission, the Planning Board and other Town Officials. This information includes red flags for protecting the most valuable of the tidal marshes and makes recommendations on sites for recreation and education.

The intent of this methodology and the resulting data is for the Town to better manage the tidal marshes for protection, recreation and education.

BACKGROUND

The following includes a brief description of tidal/salt marshes and the values and threats associated with them.

Salt Marsh Formation

There are 131 miles of tidal coastline in New Hampshire. Approximately, 7,500 acres of salt marsh are found to exist along the Atlantic coastline and around the Great Bay/Little Bay estuarine system. In geologic time, salt marshes are fairly young ecosystems. Developing over

the last four thousand years, marshes are part of the recolonization of plants and animals following the melting of the most recent glacial event. These ecosystems have developed on sediment deposits in low-lying coastal waters which are protected from excessive winds, waves and currents. Based on the frequency of saltwater flooding, marshes can be divided into two classifications, low marsh and high marsh.

Low marshes are relatively narrow fringes along river and bay shorelines. They develop where the surface elevation is below the level of mean high tide and then gently grade upland. As a result of their location, low marshes are flooded twice in a twenty-four hour period, once at each high tide. Compared to other marsh types, low marshes are more exposed to wind and wave energy and are thus more susceptible to erosive forces. Salt marsh cord grass (*Spartina alterniflora*) is the plant most commonly found in these areas.

High marsh areas create a meadow-like appearance with a distinct bank. They typically develop at the point where the surface elevation equals that of the normal high tide mark along small indentations in shoreline rivers and bays, inside meanders and in floodplain areas. Unlike low marsh, these areas are flooded only several times every other week due to storm tides or spring tides. Salt meadow cordgrass (*Spartina patens*) is the plant species found to dominate these marshes.

Spartina Alterniflora

Spartina Patens

Source: Tiner, Ralph W. Jr. A Field Guide to Coastal Wetland Plants of the Northeastern United States. 1987.

Salt Marsh Values

Marshes have succumbed to many forms of use and abuse. Historically, these areas have been looked upon as insect populated wastelands that should be drained, filled or used as dumping grounds for sewage and trash. As the urbanization of seacoast communities continues to expand, the need for suitable land to construct highways, commercial, industrial and residential housing has been at the cost of tidal marshes. They are particularly vulnerable due to the increasing demand for developable shorefront property.

Marshes from a distance may appear to be flat, featureless meadows. In truth, tidal marshes are complex ecosystems, working to protect the shoreland environment by creating a delicate balance between upland and coastal waters. Their values are well documented, but are often unknown by the general public. In general marshes help prevent shoreline erosion by dissipating wave energy and buffering ice damage in the winter, they provide protection from flooding, they improve water quality serving as a "natural treatment" for upland runoff, as well as playing an integral part of the coastal and estuarine food chain providing for a vast fish and wildlife habitat.

Marsh destruction has been due largely in part to the lack of knowledge about the ecological and hydrological values these areas hold. It is estimated that since colonial times more than fifty percent of New Hampshire's tidal marshes have already been destroyed. Salt marshes only occupy about 0.1 percent of the entire area of New Hampshire. This scarcity alone proves they are a valuable resource worthy of protection. Scientists have calculated that it would cost more than $100,000 a year to artificially duplicate the water purification and wildlife propagation provided by a single acre of natural tidal marsh. Much like the phenomenon of *the tragedy of the commons*, our wetland resources are a "common" potentially open to be exploited by development. The tragedy forms when a community sits back and permits someone to profit from development when society at large will suffer the consequences. One of the greatest assaults against the environment is the destruction of habitats for alternative land use. In the case of wetlands, the impact is always greater than the portion of land that is developed.

METHODOLOGY

The "Method for the Evaluation and Inventory of Vegetated Tidal Marshes in New Hampshire," otherwise known as the "Coastal Method", was the method used for the inventory and evaluation process in Durham, (published by the Audubon Society).

More than twenty University of New Hampshire students volunteered their time to be trained in the Coastal Method in order to complete the inventory and evaluation process for the Town.

Inventory Process

The study area for this project was developed by Audubon Society. National Wetland Inventory maps were pieced together and the Marsh Systems outlined for the Town of Durham (see Figure 1). The Marsh Systems were numbered 1 through 13 from north to south.

Base maps for individual Marsh Systems were constructed from aerial photos which were taken through the 1992 New Hampshire Coastal Mapping Project. These maps are at a scale of 1" equal 200', which provided a reasonably good view of each System and the surrounding area. The maps were used to divide each System further into Evaluation Units (EUs), where the flow of tidal water was restricted due to the construction of roads, railroads or other fill. The maps were also used to determine the acreage of each EU and to outline the area within a 500 foot Zone of Influence. Within the Zone of Influence, the number of structures could be determined from the map (to be updated with a field check). The maps served as guides in the field and were marked up with corrections during the evaluation process.

Training

Richard Cook, NH Audubon, trained the volunteers with three hours in the classroom and three hours in the field. We offered two different class days, one during the week and one on a weekend. Attendance was evenly spit between the two classes. Twenty-four students were trained, two Conservation Commissioners and one other Durham resident. All volunteers were provided with a copy of the "Coastal Method". Groups of two volunteers received a packet with the base map of the Marsh System, information regarding boat access, how to determine if there were threatened or endangered species or historical sites in their assigned area, and the data sheets necessary for completing the field evaluation.

Evaluation Process

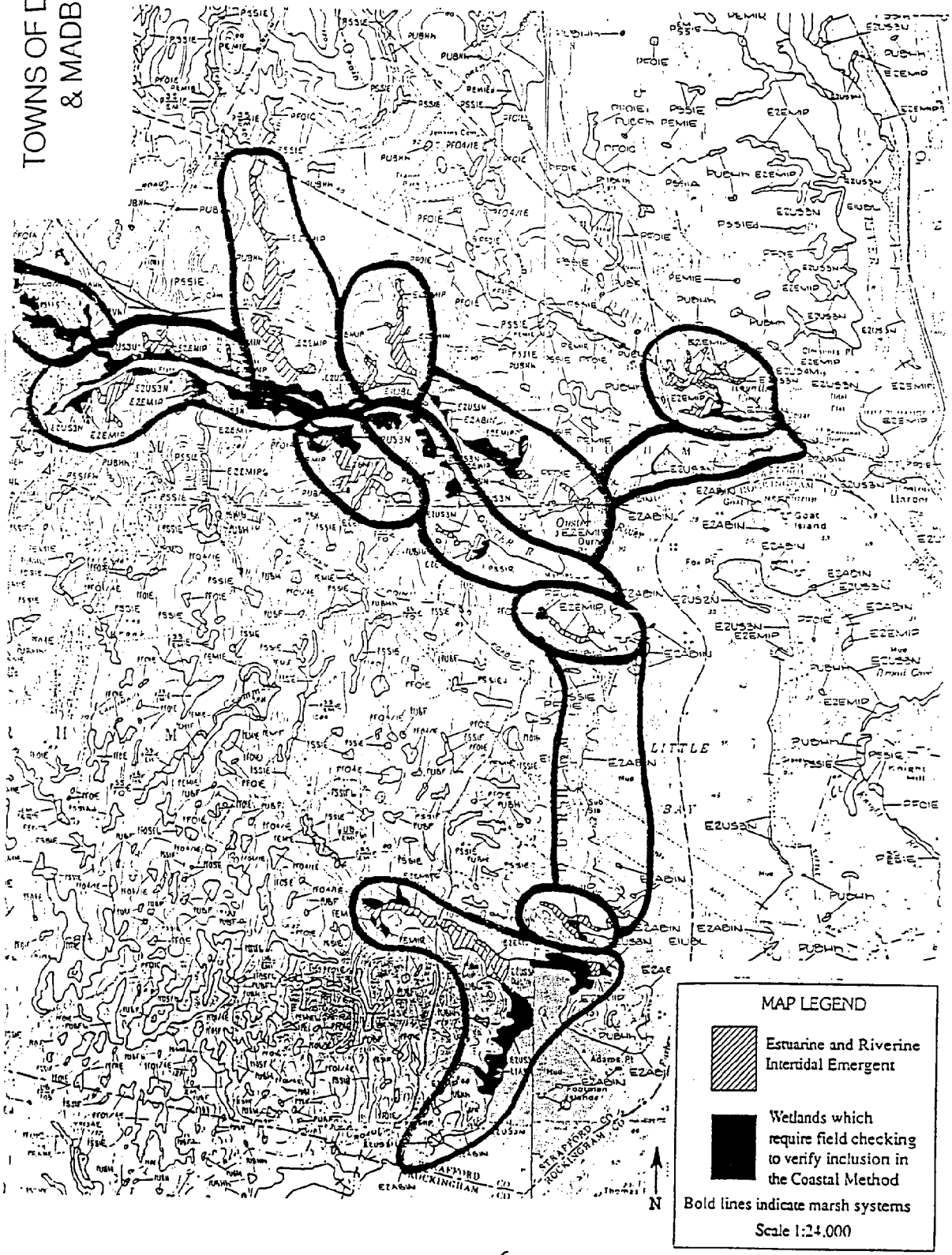
The evaluation is the process of determining the value of the tidal marsh based on an assessment of the functions that they perform. The assessment includes chemical, physical and biological processes that are important to the vitality of the marshes as well as functions that are important to the community.

The volunteers completed the data sheets from the Coastal Method which include a series of questions related to nine different marsh functions. Most questions required the volunteers to be at the marsh site in order to be answered. Other questions could be answered in the office using maps, historical registers, and other sources of information. The answers collected were based on an evaluation criteria of descriptive categories. Each category had a Functional Index score ranging from 0.1 to 1.0. Once all the questions in a function were completed, the scores were totaled, and divided by the total number of questions answered. The resulting number is referred to as the Average Functional Index or AFI. It is the AFI for each function that is the predictor of the present condition of the Marsh System or Evaluation Unit (EU).

Figure 1

TOWNS OF DURHAM & MADBURY

National Wetlands Inventory Map



Below is a list of the nine functions in the evaluation process with a brief explanation. (A complete rationale may be found in the Coastal Method Manual.)

Functions of a Marsh System:

1. **Ecological Integrity** - The extent of human development affecting (a) the marsh and (b) the surrounding upland (500 ft.).

2. **Shoreline Anchoring** - The effectiveness of the marsh in controlling and preventing shoreline erosion.

3. **Storm Surge Protection** - The ability of the marsh to protect surrounding upland from storm surges.

4. **Wildlife, Finfish, and Shellfish Habitat** - The suitability of the marsh as a habitat for those animals typically associated with tidal marshes and the upland border. No single species is emphasized.

5. **Water Quality Maintenance** - The ability of the marsh to improve the quality of the water passing through the marsh.

6. **Recreation Potential** - The potential of the marsh as a site for recreation. Shellfishing, canoeing, hunting and wildlife observation are among the recreational activities that may take place in tidal marshes.

7. **Aesthetic Quality** - The visual sense of the marsh.

8. **Education Potential** - The suitability of the marsh as an outdoor classroom. The presence of different habitats, as well as a range of wildlife and plantlife species are important to educational value of different sites.

9. **Noteworthiness** - Those attributes that are not identified in the previous functions, but may be locally or regionally significant in relation to the wetland presence.

Verifying the Data

After the volunteers returned the packets to Strafford Regional Planning Commission (SRPC), the data sheets were reviewed and corrected by staff. Audubon Society was asked to verify the data as well and provided a number of corrections. This process provided more consistent data between Marsh Systems and gave expert clarification on many points.

Data Base and Mapping

A data base was developed which included all the functional indices, average functional indices and text notes. The data base is set up so that when future evaluations are made, computations of AFIs and transfers of dependent data will take place automatically. (Errors were introduced into the data when calculating the AFIs or in transferring one score to another data sheet, by relying on the data base system for computations and automatic transfers, the level of accuracy in the data should increase.)

The Great Bay Wetland Inventory coverage was transferred by UNH, Complex Systems to SRPC. SRPC staff updated the coverage in ARC VIEW 2 to show the Marsh System boundary lines and inventory numbers. All of the maps used in this document to show site specific information collected from the field work were generated with the Great Bays Wetland coverage. To create the maps showing the Marsh Systems in the context of land-use and zoning, these coverages of the Town (available at SRPC) were overlayed with the Great Bay Wetland coverage.

RESULTS OF THE COASTAL METHOD EVALUATION

Interpreting the Results

The following tidal marsh information which was gathered through the Coastal Method provides a basis for land-use planning decisions to ensure the protection and management of tidal wetland resources. The options and recommendations provided are not an attempt to preclude the Town from developing site specific plans. The Town of Durham is encouraged to use the information gathered through the Coastal Method as well as other available resources or data to create management and protection strategies appropriate for their needs. The Town's decisions may be based on the current condition of the marsh, the present land-use in the Zone of Influence, and/or the Town's policy on future growth in the Zone of Influence.

Of the 13 Marsh Systems in Durham, nine are unobstructed and four have a tidal flow restriction. At the point of restriction, the Marsh System in broken into separate Evaluation Units. These four Marsh Systems become eight Evaluation Units. Therefore, there is a total of 17 Coastal Method evaluations for the Town of Durham. Evaluation Units are numbered 1 and 2 within the Marsh System.

There are two scores which will be referred to throughout the report. The **Functional Index (FI)**, which is the score given to each question in the data sheets, and the **Average Functional Index (AFI)**, which is an average of the sum of the Functional Indices (questions) for a particular function. The scores range from a low of 0.1 to a high of 1.0. For all functions, with the exception of Noteworthiness, an AFI greater than 0.6 is good. For the function of Noteworthiness, a score greater than 0.1 is considered good. Marsh Systems, or Evaluation Units (EUs) with high scores should be protected to maintain those valued functions. Marsh Systems which rate 0.6 or lower on functions (or 0.1 for Noteworthiness) may need immediate action to stop the degradation of the marsh.

The results of the Coastal Method evaluation are presented in four sections: (1) Summary Results, where high and low AFI scores are indicated; (2) Results by Marsh System Functions, where scores are presented by the nine functions or values of tidal marshes; (3) Results by Marsh Systems and Evaluation Units, where scores are displayed by the individual unit which was evaluated; and (4) Results of the Coastal Method Management Options Matrix. Each of these formats provide a different way to look at the data. Any one of these formats, or a combination, may be useful to portray a given perspective regarding future management of the Town's tidal marshes.

Please take special note before reviewing the results, that System 4 (EUs 1 and 2) should be reviewed with some caution. System 4 is a completely degraded tidal marsh system and should be referred to as "formerly tidal". However, the volunteers decided to evaluate the System with the Coastal Method since it appeared to be a feasible option to reclaim it as a tidal marsh. There has also been some discussion in the Town of returning Marsh System 4 to its natural state.

(1) Summary Tables of Average Functional Indices

The Coastal Method is called a non-comparative technique because there are too few tidal marshes to compromise on any one and therefore the following results formats should not be used as a tool to determine "trade- offs". Instead, the results may be used to illustrate where there may be problems affecting the entire "Marsh System Environment" in the Town, or to use as an example of the value that these resources bring to the community.

The Summary Tables show the high (Summary Table 1) and low (Summary Table 2) AFI scores for each Evaluation Unit by each function of a Marsh System. The high and lows are totaled at the bottom of each column and across the rows. This format may be used to indicate how healthy the Marsh System Environment is as a whole. There are 81 high scores and 89 low scores. The results of the Summary Tables are used throughout the remainder of the report.

Summary Table 1

Town of Durham - Coastal Wetland Average Functional Indices (High Scores)

Marsh Number	Evaluation Unit	Acreage	Ecological Integrity Part A	Ecological Integrity Part B	Shoreline Anchoring	Storm Surge Protection	Wildlife, Finfish and Shellfish Habitat	Water Quality Maintenance	Recreational Potential	Aesthetic Quality	Educational Potential	Note-worthiness	# > 0.(
1	1	14.1	1.00	0.40	0.50	0.50	0.71	0.83	0.56	0.62	0.57	0.28	+5
1	2	19.5	0.75	0.75	0.63	0.50	0.75	0.50	0.34	0.79	0.38	0.46	+6
2	1	2.5	1.00	0.20	0.65	0.10	0.41	0.70	0.25	0.59	0.22	0.28	+4
2	2	10.0	0.70	0.40	0.50	0.50	0.66	0.43	0.44	0.55	0.34	0.28	+3
3	1	20.0	1.00	0.30	0.78	0.43	0.60	0.83	0.55	0.66	0.55	0.10	+4
4	1	15.2	0.43	0.30	0.30	0.75	0.45	0.37	0.53	0.50	0.51	0.10	+1
4	2	0.3	0.33	0.65	0.30	0.55	0.38	0.10	0.40	0.55	0.58	0.10	+1
5	1	41.0	1.00	0.43	0.75	0.30	0.71	0.83	0.79	0.58	0.79	0.10	+6
6	1	9.5	1.00	1.00	0.70	0.10	0.73	0.70	0.57	0.87	0.79	0.10	+7
7	1	3.0	1.00	0.15	0.75	0.10	0.47	0.70	0.53	0.53	0.38	0.10	+3
8	1	20.0	1.00	0.46	0.63	0.50	0.59	0.83	0.32	0.76	0.18	0.28	+5
9	1	4.7	1.00	0.63	1.00	0.10	0.67	0.70	0.43	0.82	0.48	0.10	+6
10	1	4.0	1.00	0.53	0.78	0.15	0.47	0.70	0.26	0.73	0.38	0.10	+4
11	1	7.0	1.00	0.65	0.75	0.10	0.47	0.70	0.53	0.66	0.38	0.10	+5
12	1	8.0	1.00	0.88	0.50	0.30	0.73	0.70	0.75	0.95	0.62	0.82	+8
13	1	40.0	1.00	0.63	0.75	0.30	0.73	0.83	0.73	0.87	0.68	0.46	+9
13	2	10.0	0.70	0.88	0.50	0.50	0.59	0.43	0.37	0.88	0.31	0.28	+4
		# > 0.6	+15	+8	+11	+1	+8	+12	+3	+11	+4	+8	+81

Summary Table 2

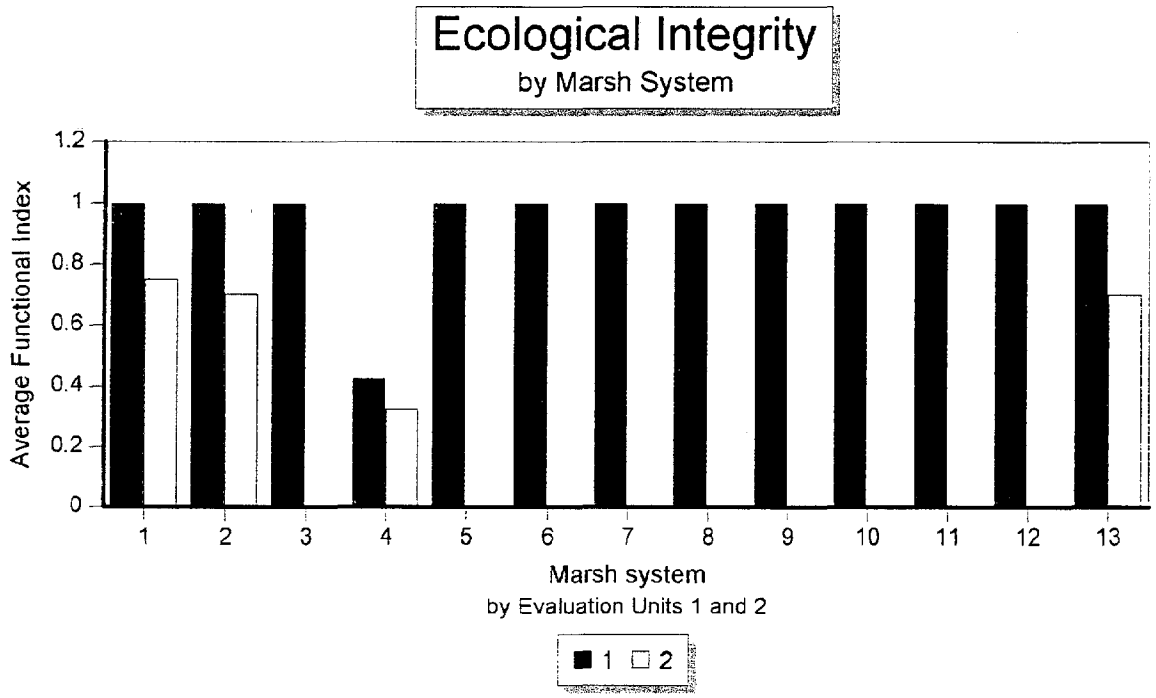
Town of Durham - Coastal Wetland Average Functional Indices (Low Scores)

Marsh Number	Evaluation Unit	Acreage	Ecological Integrity Part A	Ecological Integrity Part B	Shoreline Anchoring	Storm Surge Protection	Wildlife, Finfish and Shellfish Habitat	Water Quality Maintenance	Recreational Potential	Aesthetic Quality	Educational Potential	Note-worthiness	# <= 0.6
1	1	14.1	1.00	0.40	0.50	0.50	0.71	0.83	0.56	0.62	0.57	0.28	-5
1	2	19.5	0.75	0.75	0.63	0.50	0.75	0.50	0.34	0.79	0.38	0.46	-4
2	1	2.5	1.00	0.20	0.65	0.10	0.41	0.70	0.25	0.59	0.22	0.28	-6
2	2	10.0	0.70	0.40	0.50	0.50	0.66	0.43	0.44	0.55	0.34	0.28	-7
3	1	20.0	1.00	0.30	0.78	0.43	0.60	0.83	0.55	0.66	0.55	0.10	-6
4	1	15.2	0.43	0.30	0.30	0.75	0.45	0.37	0.53	0.50	0.51	0.10	-9
4	2	0.3	0.33	0.65	0.30	0.55	0.38	0.10	0.40	0.55	0.58	0.10	-9
5	1	41.0	1.00	0.43	0.75	0.30	0.71	0.83	0.79	0.58	0.79	0.10	-4
6	1	9.5	1.00	1.00	0.70	0.10	0.73	0.70	0.57	0.87	0.79	0.10	-3
7	1	3.0	1.00	0.15	0.75	0.10	0.47	0.70	0.53	0.53	0.38	0.10	-7
8	1	20.0	1.00	0.46	0.63	0.50	0.59	0.83	0.32	0.76	0.18	0.28	-5
9	1	4.7	1.00	0.63	1.00	0.10	0.67	0.70	0.43	0.82	0.48	0.10	-4
10	1	4.0	1.00	0.53	0.78	0.15	0.47	0.70	0.26	0.73	0.38	0.10	-6
11	1	7.0	1.00	0.65	0.75	0.10	0.47	0.70	0.53	0.66	0.38	0.10	-5
12	1	8.0	1.00	0.88	0.50	0.30	0.73	0.70	0.75	0.95	0.62	0.82	-2
13	1	40.0	1.00	0.63	0.75	0.30	0.73	0.83	0.73	0.87	0.68	0.46	-1
13	2	10.0	0.70	0.88	0.50	0.50	0.59	0.43	0.37	0.88	0.31	0.28	-6
	# < = 0.6		-2	-9	-6	-16	-9	-5	-14	-6	-13	-9	-89

(2) Results by Marsh Functions

Graphs 1A through 9 display how the 13 Marsh Systems in Durham rate overall on the nine functions of a tidal marsh. The corresponding Tables 1A through 9 show the Functional Index for each question making up the function and the overall AFI score. These are useful for analyzing why a Marsh System/EU received a particular score. For example, Graph 1A indicates that for each second EU the ecological integrity score diminishes. By looking at Table 1A it can be determined that these scores decrease because of the tidal restriction questions on this function. For each function there is a short description of how that function appears to be serving the Town of Durham.

Function Graph 1A



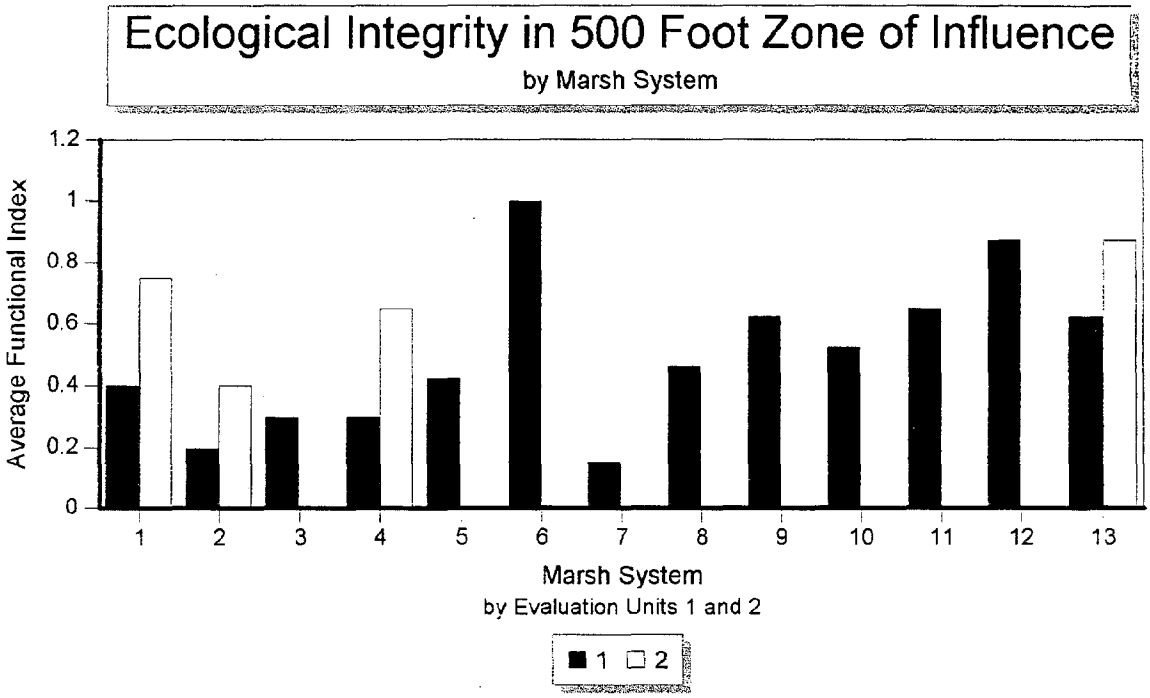
Ecological Integrity of the Marsh System/Evaluation Unit (15 EUs scored high, 2 scored low) - All Systems scored high in this function, with the exception of System 4 (which is formerly tidal). Ecological Integrity scores are lower for second EUs of a System because a restriction to tidal flow receives a lower score.

Ecological Integrity of Evaluation Unit

Function Table 1A

Marsh System	Evaluation Unit	Acreage	% Invasive Species	Number of Tidal Restrictions	Type of Tidal Restriction	Ditching on EU Surface	Average Functional Index
1	1	14.1	1.00	1.00	1.00	1.00	1.00
1	2	19.5	1.00	0.50	0.50	1.00	0.75
2	1	2.5	1.00	1.00	1.00	1.00	1.00
2	2	10.0	1.00	0.50	0.30	1.00	0.70
3	1	20.0	1.00	1.00	1.00	1.00	1.00
4	1	15.2	0.10	0.50	0.10	1.00	0.43
4	2	0.3	0.10	0.10	0.10	1.00	0.33
5	1	41.0	1.00	1.00	1.00	1.00	1.00
6	1	9.5	1.00	1.00	1.00	1.00	1.00
7	1	3.0	1.00	1.00	1.00	1.00	1.00
8	1	20.0	1.00	1.00	1.00	1.00	1.00
9	1	4.7	1.00	1.00	1.00	1.00	1.00
10	1	4.0	1.00	1.00	1.00	1.00	1.00
11	1	7.0	1.00	1.00	1.00	1.00	1.00
12	1	8.0	1.00	1.00	1.00	1.00	1.00
13	1	40.0	1.00	1.00	1.00	1.00	1.00
13	2	10.0	1.00	0.50	0.30	1.00	0.70

Function Graph 1B



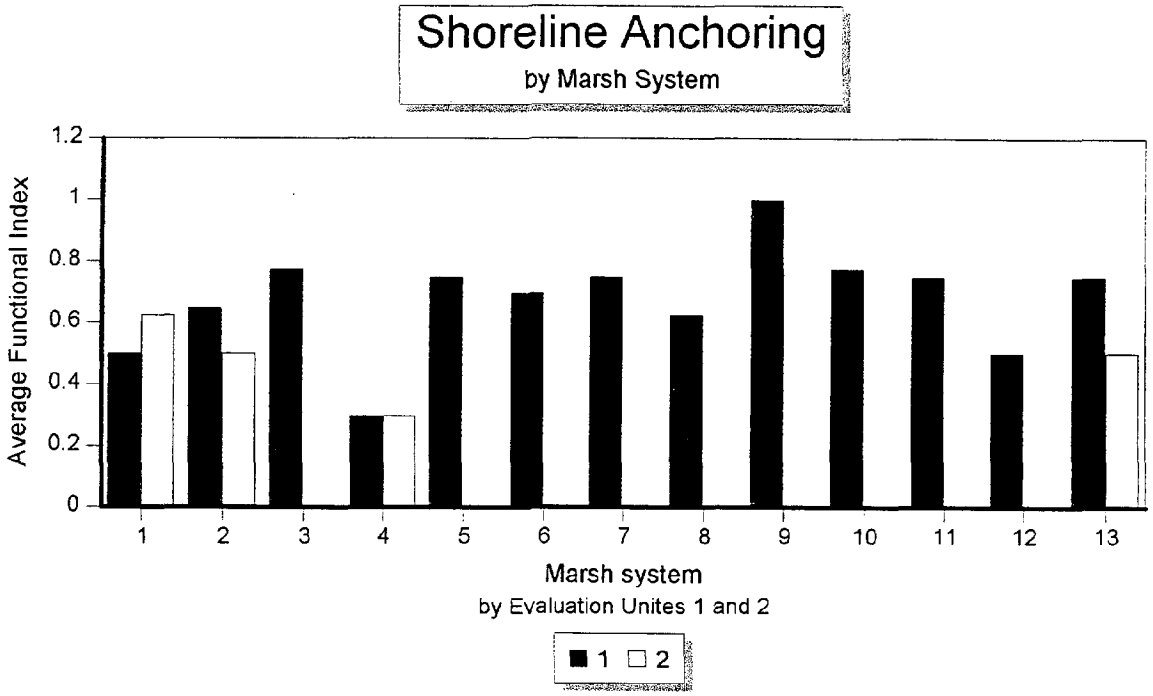
Ecological Integrity of the Zone of Influence (8 EUs scored high, 9 scored low) - Overall, these scores were lower than the Ecological Integrity of the System itself. This is due to the intensity of development within 500 feet of the vegetated tidal marsh. Surprisingly, second EUs scored higher in this function than first Eus. This is because the majority of the development is taking place within the first EU (land closest to the tidal shore). Consideration should be made to discourage development especially along the primary, or first EU.

Ecological Integrity of the Zone of Influence

Marsh System	Evaluation Unit	Acreage	Dominant Land Use	Ratio of Occupied Buildings to EU Area	% of Border with a Woodland/ Idle Land Buffer	Square Footage of Roads within 150FT of EU	Average Functional Index
1	1	14.1	0.50	0.10	0.50	0.50	0.40
1	2	19.5	1.00	0.50	0.50	1.00	0.75
2	1	2.5	0.50	0.10	0.10	0.10	0.20
2	2	10.0	0.50	0.10	0.50	0.50	0.40
3	1	20.0	0.50	0.10	0.10	0.50	0.30
4	1	15.2	0.50	0.10	0.50	0.10	0.30
4	2	0.3	0.50	1.00	1.00	0.10	0.65
5	1	41.0	0.10	0.10	0.50	1.00	0.43
6	1	9.5	1.00	1.00	1.00	1.00	1.00
7	1	3.0	0.30	0.10	0.10	0.10	0.15
8	1	20.0	0.75	0.50	0.50	0.10	0.46
9	1	4.7	0.50	0.50	0.50	1.00	0.63
10	1	4.0	0.50	1.00	0.10	0.50	0.53
11	1	7.0	0.50	1.00	0.10	1.00	0.65
12	1	8.0	1.00	1.00	0.50	1.00	0.88
13	1	40.0	0.50	0.50	0.50	1.00	0.63
13	2	10.0	1.00	1.00	0.50	1.00	0.88

Function Table 1B

Function Graph 2

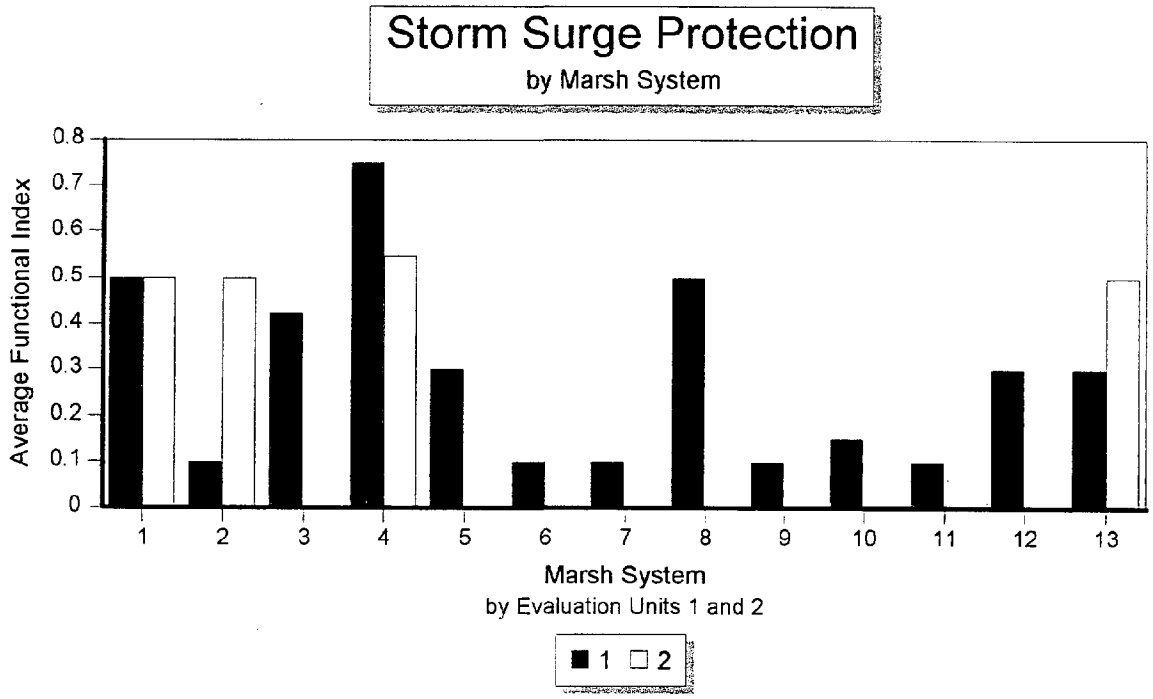


Shoreline Anchoring (11 scored high, 6 scored low) - The AFI scores for this function vary slightly across the Systems because of the type of Marsh System and the wetland morphology (whether or not there is a bank evident with or without vegetation). This function can not be improved through management of the marsh, but the marsh's ability to continue providing this function is important for the protection of the surrounding upland.

Shoreline Anchoring

Marsh System	Evaluation Unit	Acreage	Type of Marsh System	Wetland	Average Functional Index
1	1	14.1	0.50	0.50	0.50
1	2	19.5	0.50	0.75	0.63
2	1	2.5	1.00	0.30	0.65
2	2	10.0	0.50	0.50	0.50
3	1	20.0	0.65	0.90	0.78
4	1	15.2	0.10	0.50	0.30
4	2	0.3	0.10	0.50	0.30
5	1	41.0	1.00	0.50	0.75
6	1	9.5	1.00	0.40	0.70
7	1	3.0	1.00	0.50	0.75
8	1	20.0	0.50	0.75	0.63
9	1	4.7	1.00	1.00	1.00
10	1	4.0	0.80	0.75	0.78
11	1	7.0	1.00	0.50	0.75
12	1	8.0	0.50	0.50	0.50
13	1	40.0	1.00	0.50	0.75
13	2	10.0	0.50	0.50	0.50

Function Graph 3

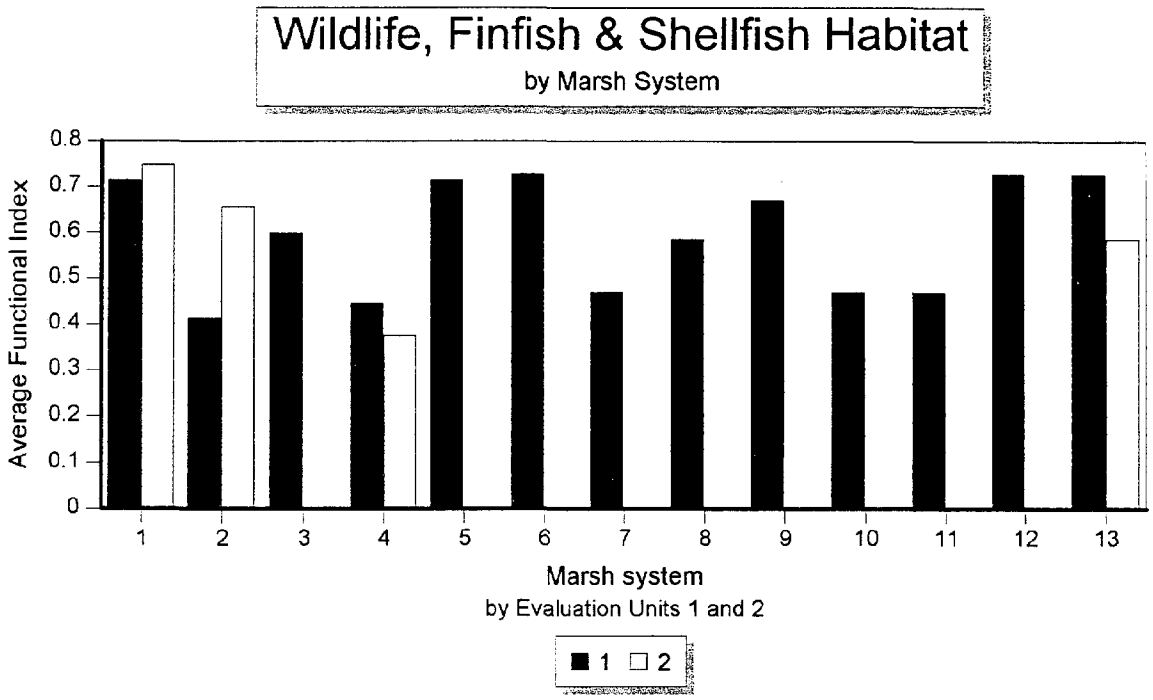


Storm Surge Protection (1 EU scored high, 16 scored low) - This function is based on acreage and marsh type and like Shoreline Anchoring can not be improved by the management of the marsh. Because most of the Systems are fringe marsh and less than 50 acres, the AFIs for this function are not high, indicating that the Marsh Systems do not perform this function extremely well in Durham.

Storm Surge Protection

Marsh System	Evaluation Unit	Acreage	Acreage of Evaluation Unit	Type of Marsh System	Average Functional Index
1	1	14.1	0.50	0.50	0.50
1	2	19.5	0.50	0.50	0.50
2	1	2.5	0.10	0.10	0.10
2	2	10.0	0.50	0.50	0.50
3	1	20.0	0.50	0.35	0.43
4	1	15.2	0.50	1.00	0.75
4	2	0.3	0.10	1.00	0.55
5	1	41.0	0.50	0.10	0.30
6	1	9.5	0.10	0.10	0.10
7	1	3.0	0.10	0.10	0.10
8	1	20.0	0.50	0.50	0.50
9	1	4.7	0.10	0.10	0.10
10	1	4.0	0.10	0.20	0.15
11	1	7.0	0.10	0.10	0.10
12	1	8.0	0.10	0.50	0.30
13	1	40.0	0.50	0.10	0.30
13	2	10.0	0.50	0.50	0.50

Function Graph 4

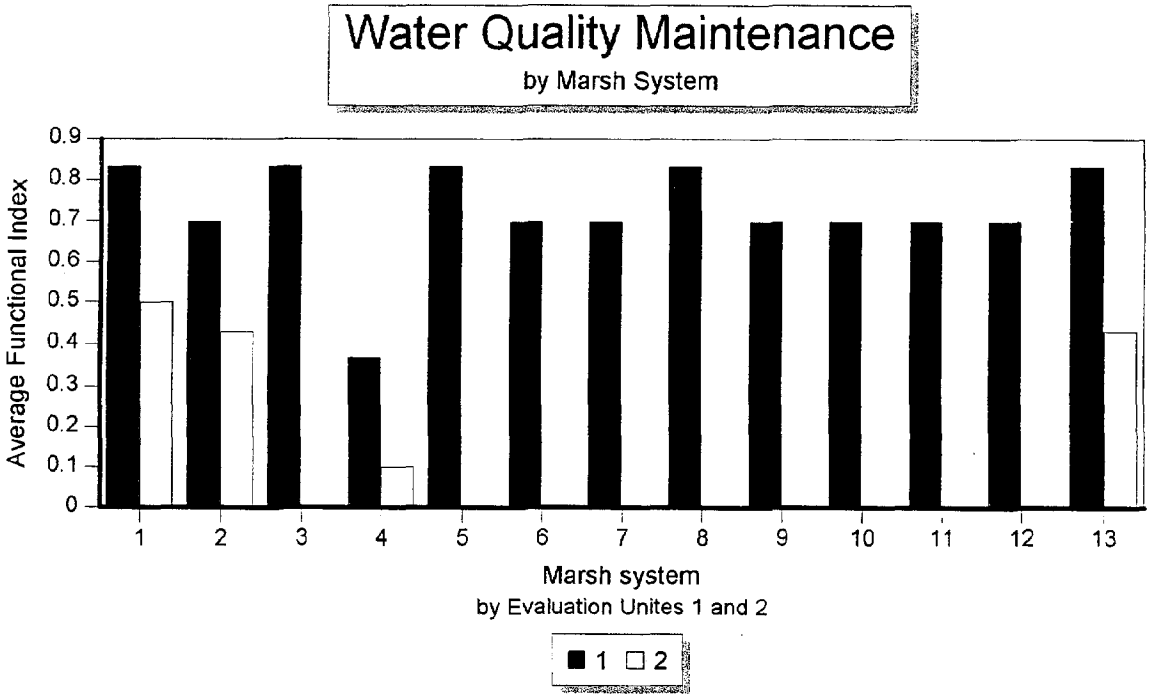


Wildlife, Finfish, Shellfish Habitat (8 EUs score high, 9 scored low) - This function looks fairly good across all the Systems. The scores here are improved by the presence of forest or idle land. If a reevaluation of the submerged vegetation is done in upcoming years the value may increase. The time of year of this evaluation (November) may not have been optimal timing for the evaluation of submerged vegetation. However, in some of the evaluations, submerged vegetation was identified.

Wildlife, Finfish & Shellfish Habitat

Marsh System	Evaluation Unit	Acreage	Acreage of the EU	Ecological Integrity of the EU	Type of Tidal Restriction	Diversity of Habitat Types	Presence of Submerged Vegetation	% of EU Bordered by Wood, Idle or Agricultural Land	Proximity to Freshwater Wetland	Average Functional Index
1	1	14.1	0.50	1.00	1.00	0.50	0.50	0.50	1.00	0.71
1	2	19.5	0.50	0.75	0.50	0.50	1.00	1.00	1.00	0.75
2	1	2.5	0.10	1.00	1.00	0.50	0.10	0.10	0.10	0.41
2	2	10.0	0.50	0.70	0.30	1.00	0.10	1.00	1.00	0.66
3	1	20.0	0.50	1.00	1.00	1.00	0.10	0.50	0.10	0.60
4	1	15.2	0.50	0.43	0.10	0.10	0.50	0.50	1.00	0.45
4	2	0.3	0.10	0.33	0.10	0.10	0.50	0.50	1.00	0.38
5	1	41.0	0.50	1.00	1.00	0.50	0.50	0.50	1.00	0.71
6	1	9.5	0.10	1.00	1.00	0.50	0.50	1.00	1.00	0.73
7	1	3.0	0.10	1.00	1.00	0.50	0.10	0.50	0.10	0.47
8	1	20.0	0.50	1.00	1.00	0.50	0.50	0.50	0.10	0.59
9	1	4.7	0.10	1.00	1.00	0.10	1.00	0.50	1.00	0.67
10	1	4.0	0.10	1.00	1.00	0.50	0.10	0.50	0.10	0.47
11	1	7.0	0.10	1.00	1.00	0.50	0.10	0.50	0.10	0.47
12	1	8.0	0.10	1.00	1.00	0.50	0.50	1.00	1.00	0.73
13	1	40.0	0.50	1.00	1.00	1.00	0.10	0.50	1.00	0.73
13	2	10.0	0.50	0.70	0.30	0.50	0.10	1.00	1.00	0.59

Function Graph 5

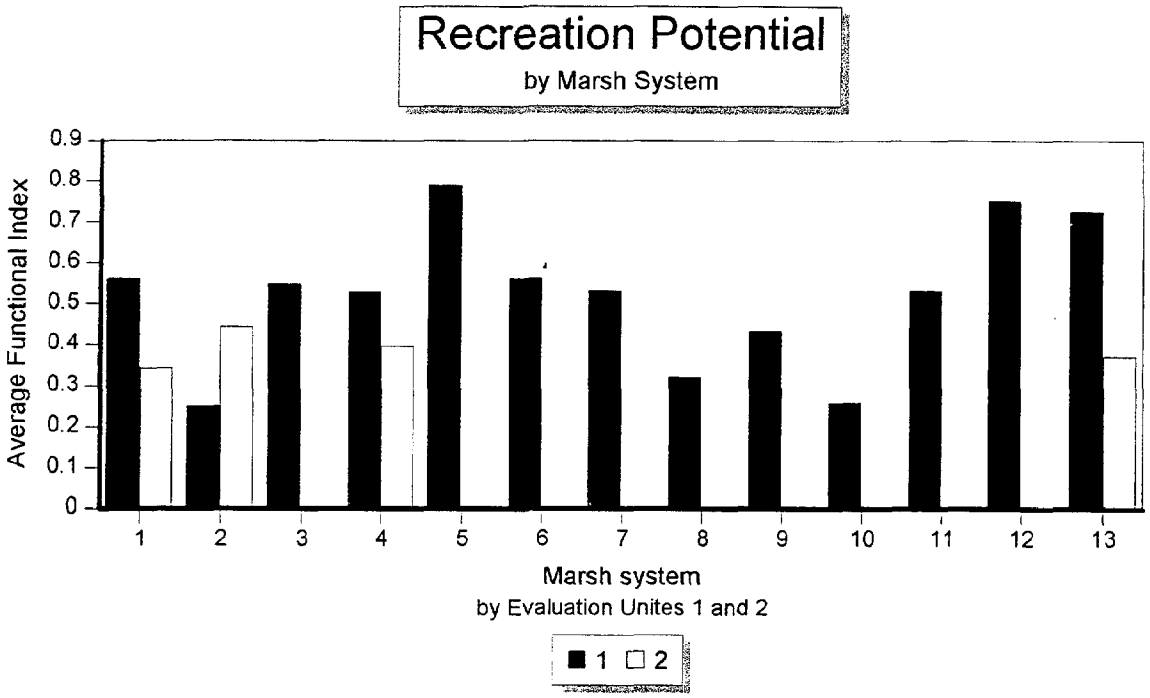


Water Quality (12 EUs scored high, 5 scored low) - The AFIs for this function are good overall for Durham. The tidal restrictions creating the second EU lowers the AFIs for Water Quality.

Water Quality Maintenance

Marsh System	Evaluation Unit	Acreage	Acreage of the EU	Number of Tidal Restrictions	Type of Tidal Restriction	Average Functional Index
1	1	14.1	0.50	1.00	1.00	0.83
1	2	19.5	0.50	0.50	0.50	0.50
2	1	2.5	0.10	1.00	1.00	0.70
2	2	10.0	0.50	0.50	0.30	0.43
3	1	20.0	0.50	1.00	1.00	0.83
4	1	15.2	0.50	0.50	0.10	0.37
4	2	0.3	0.10	0.10	0.10	0.10
5	1	41.0	0.50	1.00	1.00	0.83
6	1	9.5	0.10	1.00	1.00	0.70
7	1	3.0	0.10	1.00	1.00	0.70
8	1	20.0	0.50	1.00	1.00	0.83
9	1	4.7	0.10	1.00	1.00	0.70
10	1	4.0	0.10	1.00	1.00	0.70
11	1	7.0	0.10	1.00	1.00	0.70
12	1	8.0	0.10	1.00	1.00	0.70
13	1	40.0	0.50	1.00	1.00	0.83
13	2	10.0	0.50	0.50	0.30	0.43

Function Graph 6



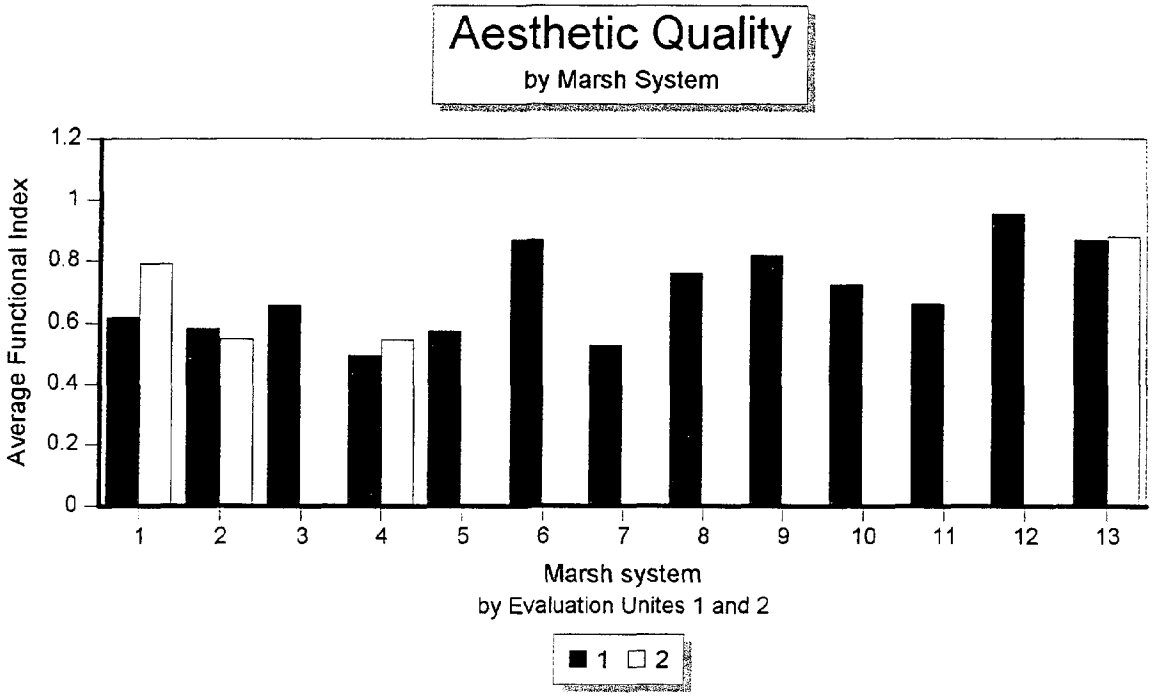
Recreation Potential (3 EUs scored high, 14 scored low) - Systems with existing trails, picnic areas, parking and hunting receive the highest AFIs on this function. All of the Systems have canoe access. These scores could improve if the shell beds open for harvest and if trails, board walks and/or parking are made available.

Recreation Potential

Marsh System	Evaluation Unit	Acreage	Presence of Shellfish Beds	Waterfowl Hunting	Wildlife Observation	Canoe/Boat Passage	Canoe/Boat Access	Off-Road Public Parking	Handicap Accessibility	Presence of Visitors Center Trails or Boardwalks	Average Functional Index
1	1	14.1	0.10	1.00	0.71	1.00	0.50	1.00	0.10	0.10	0.56
1	2	19.5	0.10	0.50	0.75	1.00	0.10	0.10	0.10	0.10	0.34
2	1	2.5	0.10	0.10	0.41	1.00	0.10	0.10	0.10	0.10	0.25
2	2	10.0	0.50	1.00	0.66	1.00	0.10	0.10	0.10	0.10	0.44
3	1	20.0	0.10	0.50	0.60	1.00	1.00	1.00	0.10	0.10	0.55
4	1	15.2	0.10	0.10	0.45	1.00	1.00	1.00	0.50	0.10	0.53
4	2	0.3	0.10	0.50	0.38	0.50	0.50	1.00	0.10	0.10	0.40
5	1	41.0	0.10	1.00	0.71	1.00	1.00	1.00	1.00	0.50	0.79
6	1	9.5	0.10	0.10	0.73	1.00	1.00	1.00	0.10	0.50	0.57
7	1	3.0	0.50	0.10	0.47	1.00	1.00	1.00	0.10	0.10	0.53
8	1	20.0	0.50	0.10	0.59	1.00	0.10	0.10	0.10	0.10	0.32
9	1	4.7	0.50	0.10	0.67	1.00	0.50	0.50	0.10	0.10	0.43
10	1	4.0	0.10	0.10	0.47	1.00	0.10	0.10	0.10	0.10	0.26
11	1	7.0	1.00	0.10	0.47	1.00	1.00	0.50	0.10	0.10	0.53
12	1	8.0	1.00	0.75	0.73	1.00	1.00	1.00	0.30	0.25	0.75
13	1	40.0	1.00	0.50	0.73	1.00	1.00	1.00	0.50	0.10	0.73
13	2	10.0	0.10	0.10	0.59	0.50	1.00	0.50	0.10	0.10	0.37

Function Table 6

Function Graph 7



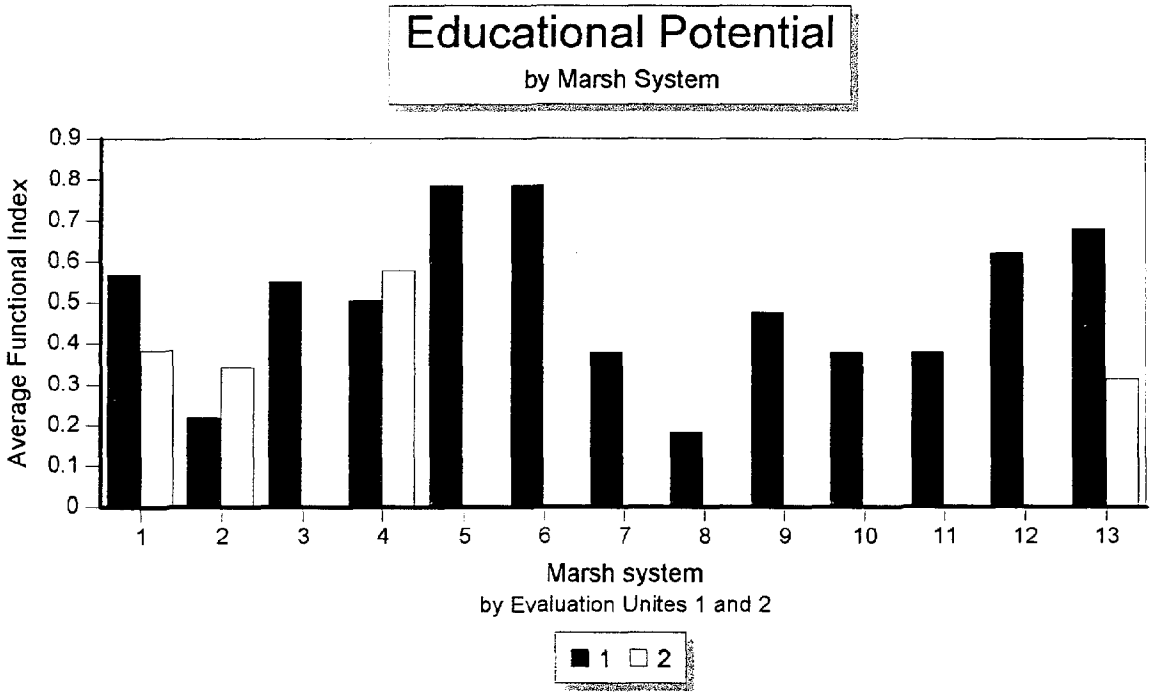
Aesthetic Quality (11 EUs scored high, 6 scored low) - Surprisingly, Systems 2, 4, 5 and 7 scored low on this function. Aesthetic Quality is compromised because of the development taking place within the Zone of Influence. Noise from traffic on Routes 4 and 108 also reduced this function. In Systems 1, 2 and 5, the evaluators noted that odors from the waste water treatment plant affected Aesthetic Quality.

Aesthetic Quality

Marsh System	Evaluation Unit	Acreage	Ecological Integrity of the EU	Wildlife Observation	Land-Use Surrounding the EU	General Appearance of the EU	Noise Level	Odors Present	Average Functional Index
1	1	14.1	1.00	0.71	0.50	0.50	0.50	0.50	0.62
1	2	19.5	0.75	0.75	1.00	1.00	0.50	0.75	0.79
2	1	2.5	1.00	0.41	0.50	0.50	0.10	1.00	0.59
2	2	10.0	0.70	0.66	0.10	0.75	0.10	1.00	0.55
3	1	20.0	1.00	0.60	0.50	0.75	0.10	1.00	0.66
4	1	15.2	0.43	0.45	0.50	0.10	0.50	1.00	0.50
4	2	0.3	0.33	0.38	1.00	0.10	0.50	1.00	0.55
5	1	41.0	1.00	0.71	0.50	0.50	0.25	0.50	0.58
6	1	9.5	1.00	0.73	1.00	1.00	0.50	1.00	0.87
7	1	3.0	1.00	0.47	0.50	0.10	0.10	1.00	0.53
8	1	20.0	1.00	0.59	0.50	0.50	1.00	1.00	0.76
9	1	4.7	1.00	0.67	0.50	0.75	1.00	1.00	0.82
10	1	4.0	1.00	0.47	0.75	0.25	0.90	1.00	0.73
11	1	7.0	1.00	0.47	0.50	0.50	0.50	1.00	0.66
12	1	8.0	1.00	0.73	1.00	1.00	1.00	1.00	0.95
13	1	40.0	1.00	0.73	0.50	1.00	1.00	1.00	0.87
13	2	10.0	0.70	0.59	1.00	1.00	1.00	1.00	0.88

Function Table 7

Function Graph 8

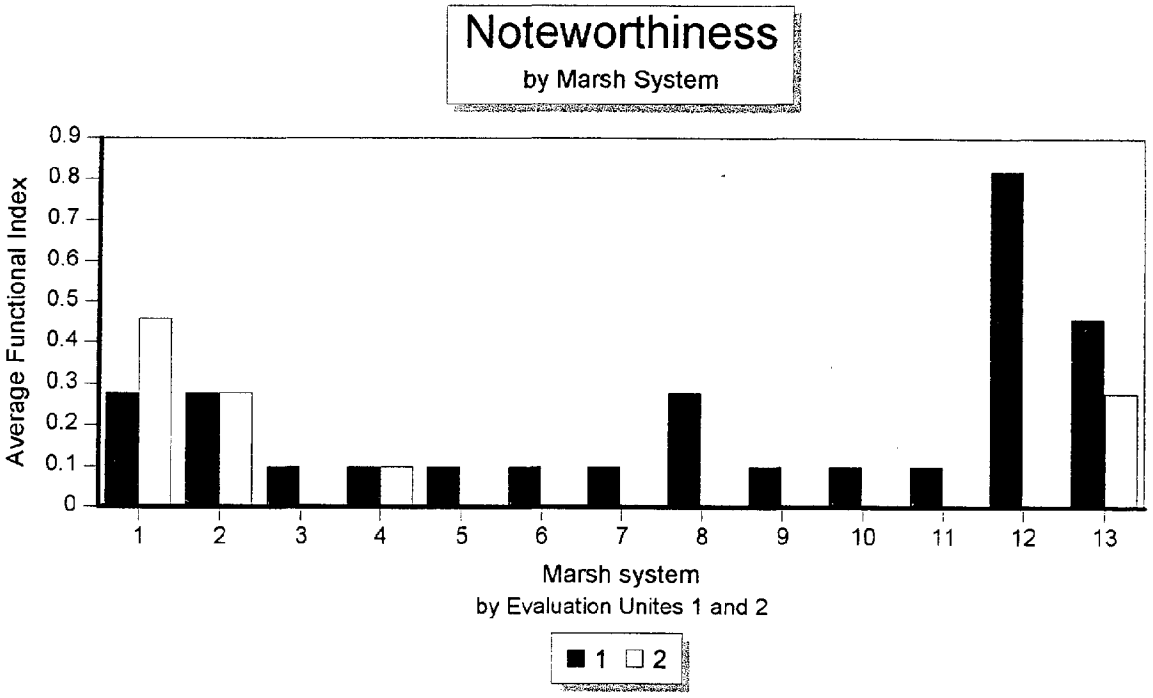


Education Potential (4 EUs scored high, 13 scored low) - Student safety, existing facilities, parking and a variety of habitats to observe make Systems 5, 6, 12 and 13.1 the most favorable education sites in Durham.

Educational Potential

Marsh System	Evaluation Unit	Acreage	Wildlife Observation	Presence of Visitors Center, Trails or Board Walks	Proximity to Other Habitats	Off-Road Parking for School Vehicles	Student Safety	Handicap Access	Average Functional Index
1	1	14.1	0.71	0.10	1.00	1.00	0.50	0.10	0.57
1	2	19.5	0.75	0.10	0.50	0.75	0.10	0.10	0.38
2	1	2.5	0.41	0.10	0.50	0.10	0.10	0.10	0.22
2	2	10.0	0.66	0.10	1.00	0.10	0.10	0.10	0.34
3	1	20.0	0.60	0.10	1.00	1.00	0.50	0.10	0.55
4	1	15.2	0.45	0.10	1.00	0.50	0.50	0.50	0.51
4	2	0.3	0.38	0.10	1.00	1.00	0.50	0.50	0.58
5	1	41.0	0.71	0.50	1.00	1.00	1.00	0.50	0.79
6	1	9.5	0.73	0.50	1.00	1.00	1.00	0.50	0.79
7	1	3.0	0.47	0.10	0.10	1.00	0.50	0.10	0.38
8	1	20.0	0.59	0.10	0.10	0.10	0.10	0.10	0.18
9	1	4.7	0.67	0.10	1.00	0.50	0.50	0.10	0.48
10	1	4.0	0.47	0.10	1.00	0.10	0.50	0.10	0.38
11	1	7.0	0.47	0.10	1.00	0.10	0.50	0.10	0.38
12	1	8.0	0.73	0.25	1.00	1.00	0.50	0.25	0.62
13	1	40.0	0.73	0.10	1.00	1.00	0.75	0.50	0.68
13	2	10.0	0.59	0.10	0.50	0.50	0.10	0.10	0.31

Function Graph 9



Noteworthiness (8 EUs scored high, 9 scored low) - Systems 1, 2, 8, 12 and 13 received AFIs over 0.1, which makes them "Noteworthy". These Systems need the highest level of protection to ensure that the significant or unique quality which makes the site noteworthy is never compromised.

Noteworthiness

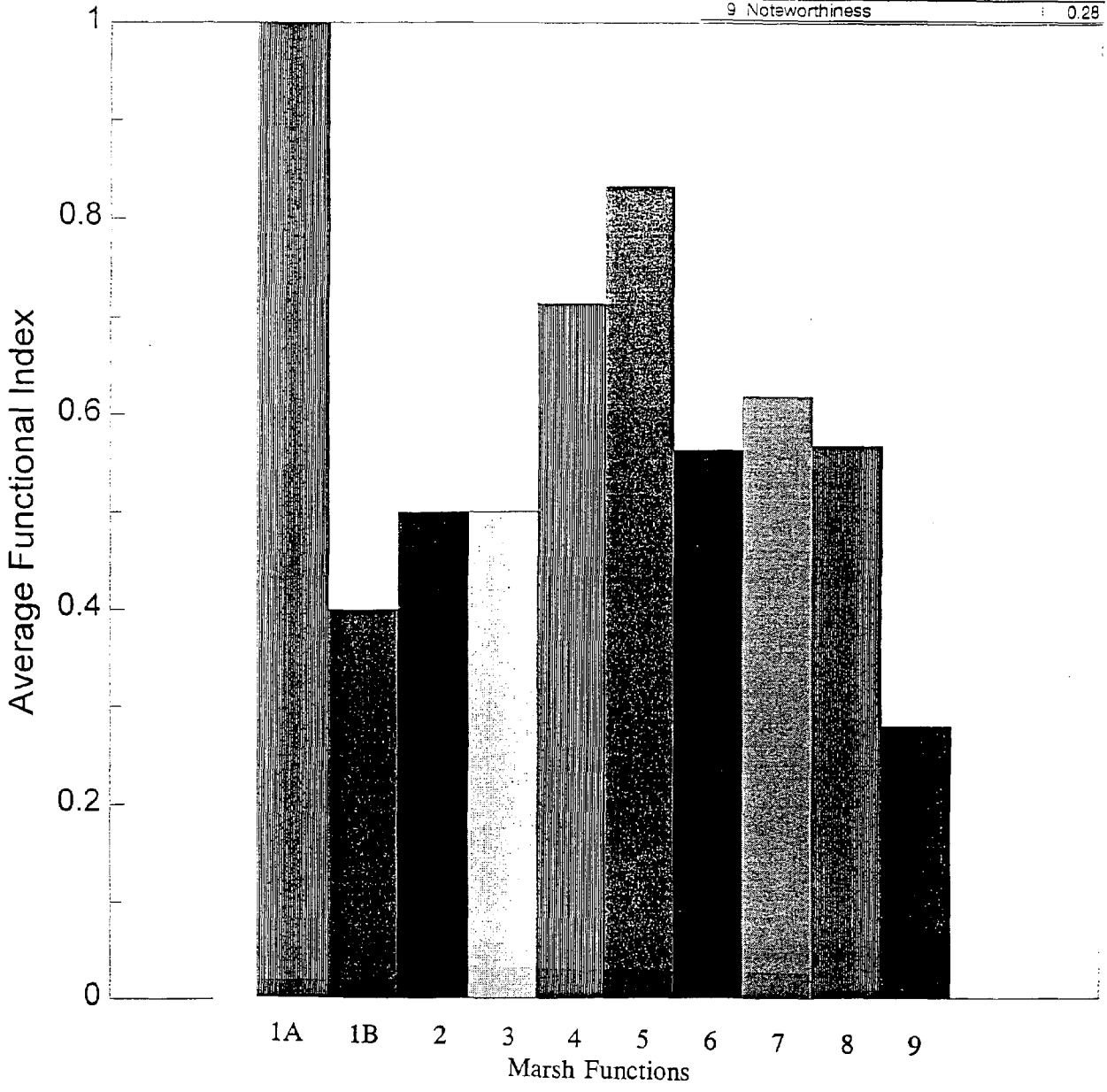
Marsh System	Evaluation Unit	Acreage	Habitat for federally threatened or endangered species	Features of Significance	Contain site of Historical Significance	Tide Marsh in Urban Setting	EU Used as Long Term Research Site	Average Functional Index
1	1	14.1	1.00	0.10	0.10	0.10	0.10	0.28
1	2	19.5	1.00	1.00	0.10	0.10	0.10	0.46
2	1	2.5	0.10	0.10	0.10	1.00	0.10	0.28
2	2	10.0	0.10	0.10	0.10	1.00	0.10	0.28
3	1	20.0	0.10	0.10	0.10	0.10	0.10	0.10
4	1	15.2	0.10	0.10	0.10	0.10	0.10	0.10
4	2	0.3	0.10	0.10	0.10	0.10	0.10	0.10
5	1	41.0	0.10	0.10	0.10	0.10	0.10	0.10
6	1	9.5	0.10	0.10	0.10	0.10	0.10	0.10
7	1	3.0	0.10	0.10	0.10	0.10	0.10	0.10
8	1	20.0	1.00	0.10	0.10	0.10	0.10	0.28
9	1	4.7	0.10	0.10	0.10	0.10	0.10	0.10
10	1	4.0	0.10	0.10	0.10	0.10	0.10	0.10
11	1	7.0	0.10	0.10	0.10	0.10	0.10	0.10
12	1	8.0	1.00	1.00	1.00	0.10	1.00	0.82
13	1	40.0	1.00	0.10	0.10	0.10	1.00	0.46
13	2	10.0	1.00	0.10	0.10	0.10	0.10	0.28

(3) Results by Marsh Systems and Evaluation Units

The following text includes graphs, tables and notes for each Evaluation Unit. Data displayed in this format may be useful when dealing with a potential threat which is directed at an individual Marsh System or Evaluation Unit, and for specific management plans for each. The notes listed in this section were taken in the field by the volunteer evaluators. Any recommendations given in this section have been transferred to the final recommendations section of the report.

Marsh System 1 EU 1
Average Functional Indices

1A	Ecological Integrity Part A	1.00
1B	Ecological Integrity Part B	0.40
2	Shoreline Anchoring	0.50
3	Storm Surge Protection	0.50
4	Wildlife, Finfish and Shellfish Habitat	0.71
5	Water Quality Maintenance	0.83
6	Recreational Potential	0.56
7	Aesthetic Quality	0.62
8	Educational Potential	0.57
9	Noteworthiness	0.28



MARSH SYSTEM 1 EVALUATION UNIT 1

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Potential industrial park development on the west bank, lot is clear cut with a road running through the middle, leaving wetlands unprotected from freshwater overland flow
*There are 13 occupied buildings within the EU and Zone of Influence
*3600ft of the 8600ft EU perimeter has a woodland buffer
*There is approximately 36000sqft of paved road with in 150ft of the EU

Shoreline Anchoring

*Some areas have a more distinct bank than others

Storm Surge Protection

*No Notes

Wildlife, Finfish, Shellfish Habitat

*Habitat types: Tidal flats, shallow pannes, fresh water source, open water, high marsh, low marsh

Water Quality Maintenance

*No Notes

Recreational Potential

*EU accessible and used by hunters
*Canoe/boat access from Jackson Landing <1 mile west
*Off road parking at industrial park site

Aesthetic Quality

*Land use surrounding EU contains few houses, wooded lots, fields and Rte. 4
*Moderate noise level from Rte. 4 traffic
*Unnatural odors present from the Town of Durham Waste Treatment Facility

Educational Potential

*Other habitats include the river, open land, and upland forest
*Off road parking for school buses can be found on the industrial park site
*There is a concern for student safety due to the volume and the speed or Rte. 4 traffic

Noteworthiness

*No Notes

Summary

Potential industrial park and residential encroachment seems like the biggest potential hazard for this EU. The east side of the marsh is already developed, somewhat, and the west side appears to be in the early stages of housing development. The road that appears to be for industrial development serves as easy access to the EU. This access could provide for both recreational and educational purposes, its availability is questionable once the parcel of land is developed. Phragmites has been established along Rt. 4 it appears small now, but could spread into the marsh given time. Immediate attention should be taken to prevent this.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No restrictions, direct outlet to the Oyster River

Percent of the EU dominated by invasive species.

*Less than 5% of the EU is dominated by invasive species (Phragmites australis)

Acreage of fill deposited on the marsh surface.

*No fill deposition observed at site. From Rt. 4, there must have been some fill from construction, but plant life has been re-established.

Existing plant community located on fill.

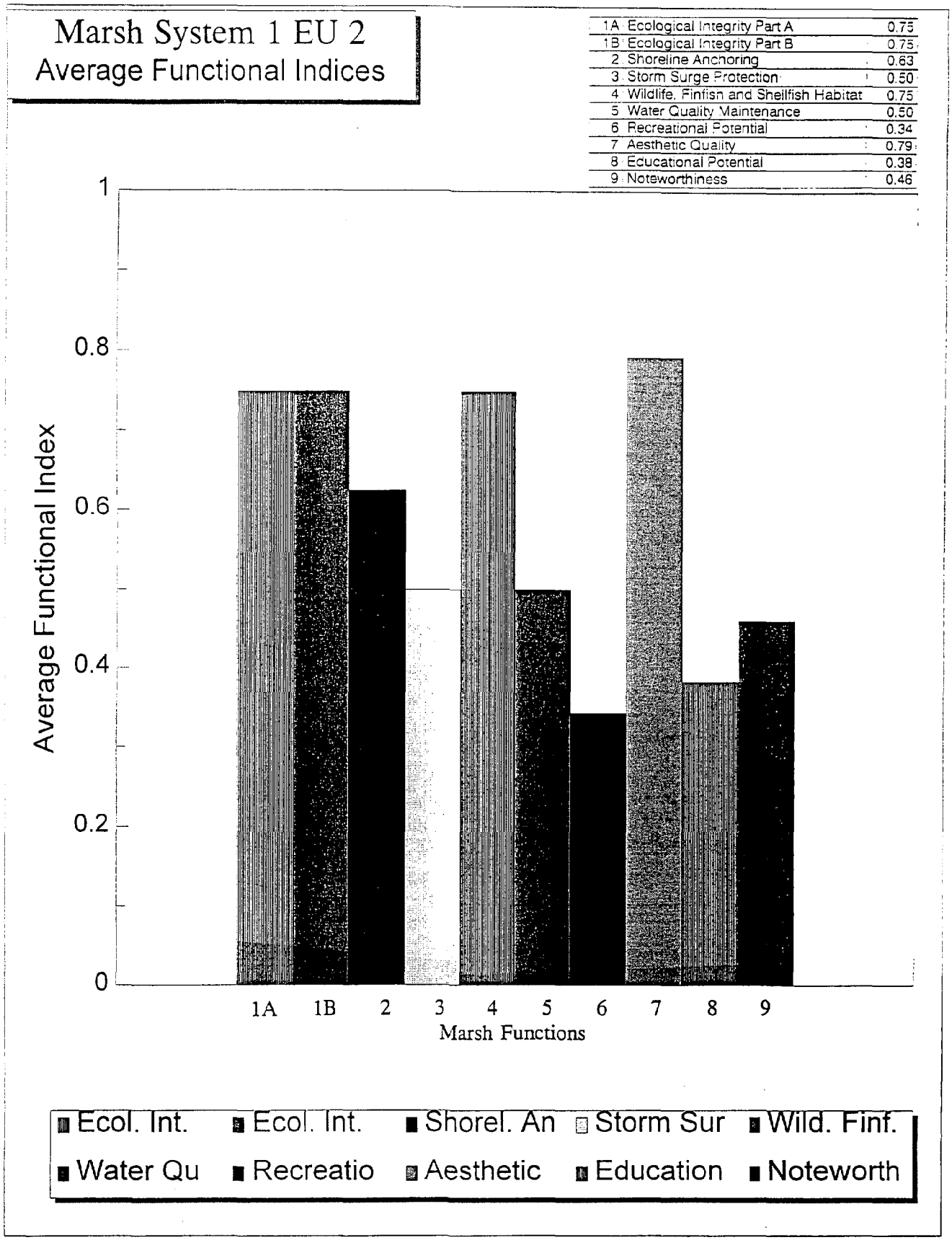
*Invaded by terrestrial species on roadside (Phragmites).

Presence of structures on the fill.

*Rte. 4

Other causes of degradation.

*Suburban encroachment, runoff form residential community into the EU, mowing of clear cut industrial lots and runoff from Rte. 4.


Marsh System 1 EU 2
Average Functional Indices
1A Ecological Integrity Part A 0.75
1B Ecological Integrity Part B 0.75
2 Shoreline Anchoring 0.63
3 Storm Surge Protection 0.50
4 Wildlife, Finfish and Shellfish Habitat 0.75
5 Water Quality Maintenance 0.50
6 Recreational Potential 0.34
7 Aesthetic Quality 0.79
8 Educational Potential 0.38
9 Noteworthiness 0.46
Average Functional Index
1
0.8
0.6
0.4
0.2
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MARSH SYSTEM 1 EVALUATION UNIT 2

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Minimal damming effect from the Rte. 4 bridge blocking the marsh from the tide
*Ditches were seen running East-West to the creek
*There are 2 occupied buildings within the EU and the Zone of Influence
*2200ft of the 4000ft EU perimeter has a woodland buffer
*There is approximately 22600SF of paved surfaces within 150 of the EU

Shoreline Anchoring

*The quality of banks varies throughout the whole EU, most of the EU has no distinct bank at all
*A majority of those areas that do have banks are protected by vegetation

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Pannes, high marsh, low marsh, mud flats, fresh water source, fresh water tidal marsh
*3000ft of the 4000ft EU perimeter has a woodland OR agricultural buffer

Water Quality Maintenance

*No Notes

Recreational Potential

*EU appeared to be privately owned, an owner designated "Natural Area", no evidence of hunting
*Boat/Canoe access from Jackson Landing, >1 mile west of EU
*EU only navigable during high tide with a non-powered boat
*No good off road public parking; Rte. 4 is very dangerous

Aesthetic Quality

*Moderate noise levels from Rte. 4 traffic
*Slight unnatural odors from the Town of Durham Waste Treatment Facility

Educational Potential

*Other habitats include: river, and forest
*No safe parking available for school buses or related vehicles

Noteworthiness

*State's best example of freshwater tidal marsh, containing a plant community rare in NH

Summary

*This EU is not strongly affected by the Rte. 4 bridge. The bridge does not seem to be a significant restriction to water flow into the EU, although, season and spring tides may be restricted. Absence of invasive or terrestrial plants on this salt marsh supports our conclusion that there is adequate flow. On the south east side of the EU is a single eroded embankment. It is adjacent to a residence and on the outside of a stream meander. It is approximately 3 - 5 meters in height.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*One tidal restriction, bridge for Rte. 4. It seems to be adequate for tidal flow.

Percent of the EU dominated by invasive species.

*No significant invasive species observed.

Acreage of fill deposited on the marsh surface.

*No fill observed at this site. Fill had to be used in the construction of Rte. 4, but plant life has been re-established.

Existing plant community located on fill.

*Terrestrial species have invaded roadside.

Presence of structures on the fill.

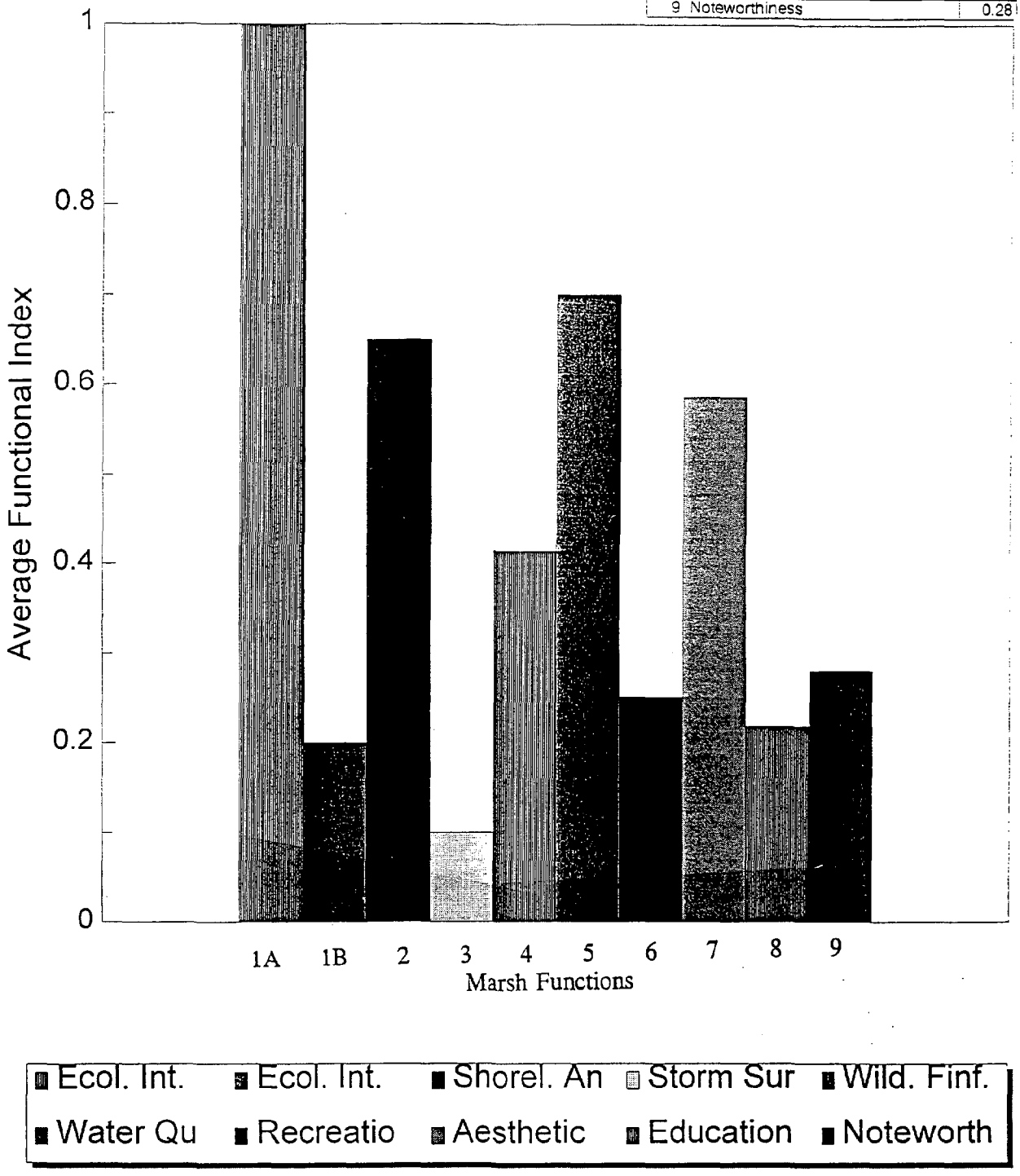
*Rte. 4 bridge

Other causes of degradation.

*Steep and eroded embankment near residence on south end of EU, near Rte. 4.

Marsh System 2 EU 1
Average Functional Indices

1A	Ecological Integrity Part A	1.00
1B	Ecological Integrity Part B	0.20
2	Shoreline Anchoring	0.65
3	Storm Surge Protection	0.10
4	Wildlife, Finfish and Shellfish Habitat	0.41
5	Water Quality Maintenance	0.70
6	Recreational Potential	0.25
7	Aesthetic Quality	0.59
8	Educational Potential	0.22
9	Noteworthiness	0.28



MARSH SYSTEM 2 EVALUATION UNIT 1

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*There are 19 occupied structures within the EU and the Zone of Influence
*0 of the 3400ft EU perimeter is buffered by woodland
*There is approximately 50400SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Open water, tidal flats, high marsh, low marsh

Water Quality Maintenance

*No Notes

Recreational Potential

*Scatttered sites of shellfish beds; none of recreational value
*No boat access on site; Jackson Landing >1 mile west
*No legal parking along Rte. 4
*No handicap accessibility to the marsh, but it can be seen from the road

Aesthetic Quality

*Heavy traffic on Rte. 4, land use is predominantly rural residential
*Road and housing along the shore detracts the appearance
*Some trash found around docks, no invasive species present
*Traffic creates a loud noise level
*Natural odors only

Educational Potential

*Other habitats: River, forest land
*No suitable off road parking for school vehicles, Rte. 4 is very dangerous for students to cross
*Walking the marsh we fell into hidden crevasses and holes many times, not recommended for children

Noteworthiness

*Marsh is in a high density area; 19 structures in an almost 3AC setting

Summary

Overall the marsh system has been impacted by close proximity of rural housing, with 16 buildings within the Zone of Influence. The EU being so small, the potential and ongoing impact could be considerable. There was some changes seen along the shoreline like the formation of retaining walls, docks, and water outfalls were noted. The EU runs along Rte. 4 , and proves to be a very hazardous area. Also there was a small compost pile near the site. Also a rocky bank bordered a large portion of the marsh possibly creating extra runoff in spring (no slowing by vegetation).

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*No notes

Acreage of fill deposited on the marsh surface.

*No notes

Existing plant community located on fill.

*No notes

Presence of structures on the fill.

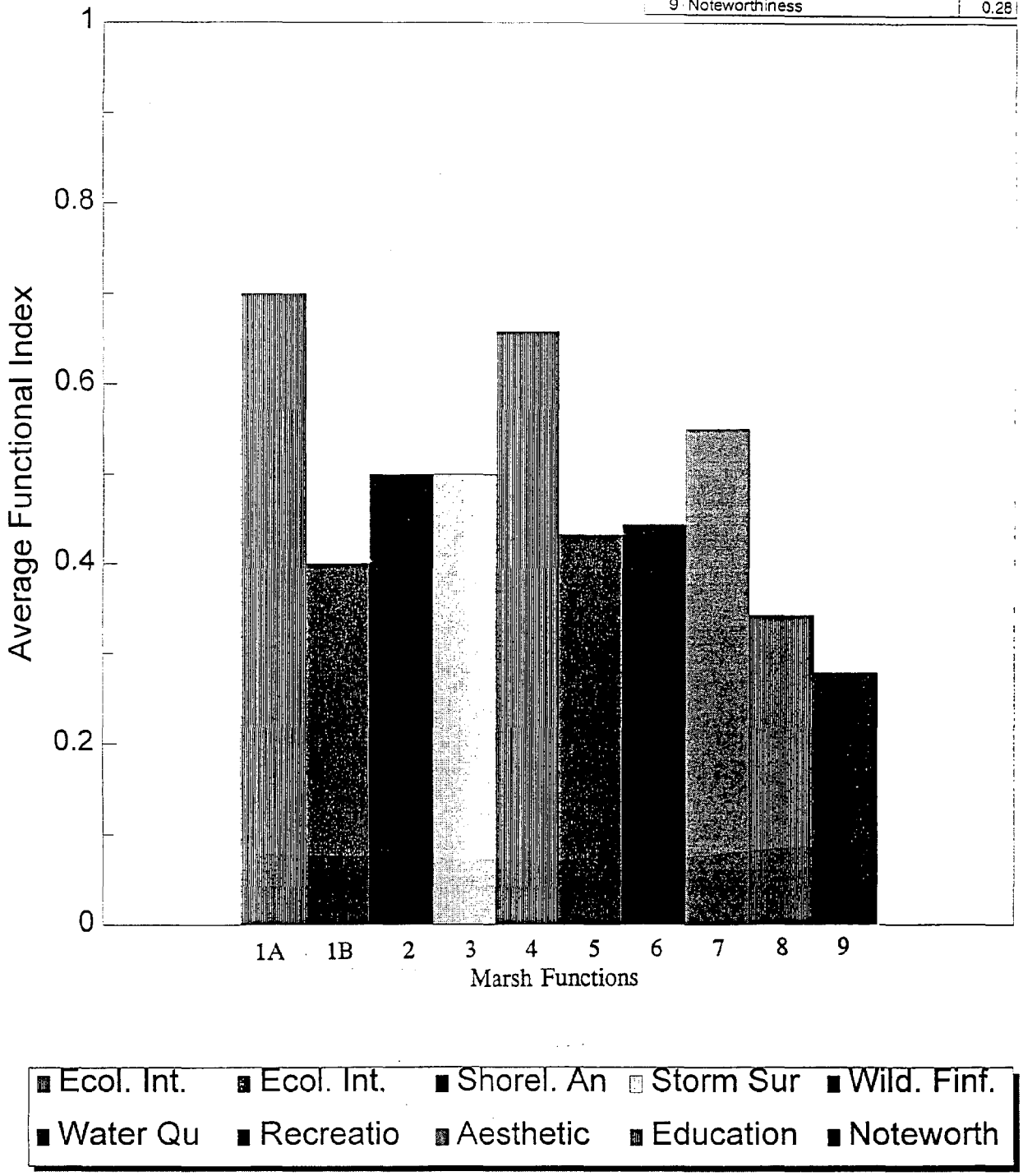
*No notes

Other causes of degradation.

*No notes

Marsh System 2 EU 2
Average Functional Indices

1A	Ecological Integrity Part A	0.70
1B	Ecological Integrity Part B	0.40
2	Shoreline Anchoring	0.50
3	Storm Surge Protection	0.50
4	Wildlife, Finfish and Shellfish Habitat	0.66
5	Water Quality Maintenance	0.43
6	Recreational Potential	0.44
7	Aesthetic Quality	0.55
8	Educational Potential	0.34
9	Noteworthiness	0.28



MARSH SYSTEM 2 EVALUATION UNIT 2

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Some cattail (<5%) located near the fresh water source
*Water flow through the bridge appeared to be adequate, but water was pooling behind the bridge
*Noted heavy traffic on Rte. 4
*There are 7 occupied structures in the EU and Zone of Influence
*3200FT of the 6000FT EU perimeter is buffered by woodland
*There is approximately 28800SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*No Notes

Water Quality Maintenance

*No Notes

Recreational Potential

*Scattered Oyster and Mussel shellfish beds; Posted closed for harvest
*No boat access on site, no safe or legal parking within a 20 minute walk
*Closest boat access is Jackson Landing, >1 mile west or Hilton Point >1 mile east
*No handicap accessibility on marsh, but it can be seen from the road

Aesthetic Quality

*Heavy traffic from Rte. 4, creating loud continuous noise
*Rte. 4 is the major visual detractor for the marsh

Educational Potential

*Other habitats: Forest, river
*Absolutely no parking for school vehicles
*Crossing Rte. 4 is very hazardous especially with a group of students
*It is very easy to twist you ankle or even break a leg falling into hidden crevasses and holes in the marsh
*Not safe for children to run around on the main part of the marsh

Noteworthiness

*There have been eagle, osprey, and blue heron sightings, but this is not a habitat for these species

Summary

Overall the EU appears to be undisturbed, except for the road (Rte. 4). The EU itself had very little evidence of anyone walking around or disturbing it. No trash was seen in the marsh, only a small amount of debris was seen from the road area. The EU appeared to by in good shape considering its close proximity to the road. The EU is in a dangerous area along Rte. 4 and has no real direct access to the marsh system. This area provides a good aesthetic quality considering its close proximity to rural housing

and Rte. 4. The marsh system may also provide a good habitat for a wide diversity of plants and animals. The EU is very nice because it has many habitat types.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*No notes

Acreage of fill deposited on the marsh surface.

*No notes

Existing plant community located on fill.

*No notes

Presence of structures on the fill.

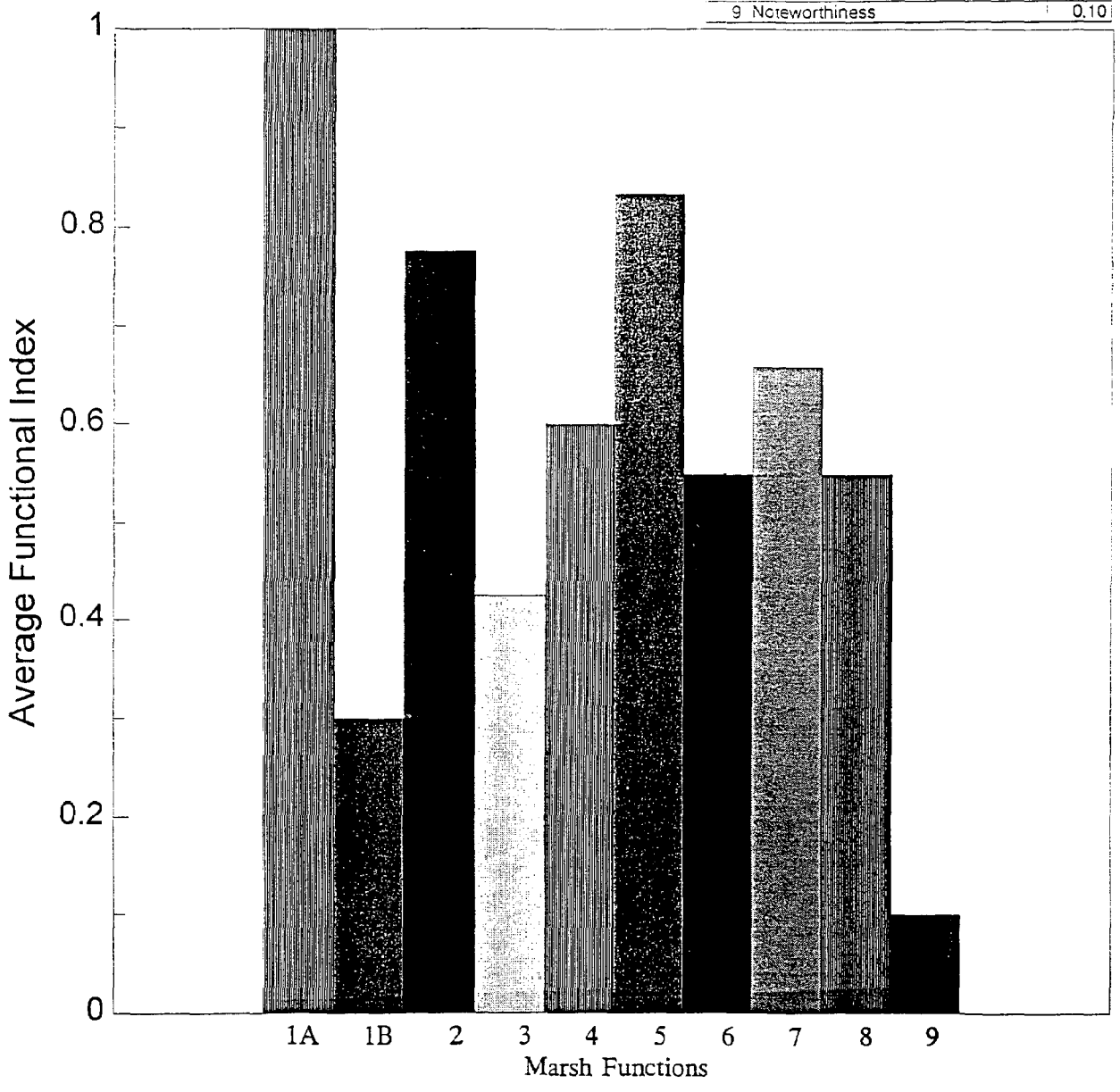
*No notes

Other causes of degradation.

*No notes

Marsh System 3
Average Functional Indices

1A	Ecological Integrity Part A	1.00
1B	Ecological Integrity Part B	0.30
2	Shoreline Anchoring	0.78
3	Storm Surge Protection	0.43
4	Wildlife, Finfish and Shellfish Habitat	0.60
5	Water Quality Maintenance	0.83
6	Recreational Potential	0.55
7	Aesthetic Quality	0.66
8	Educational Potential	0.55
9	Noteworthiness	0.10



MARSH SYSTEM 3

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Less than 5% of marsh plant community is phragmites
*Mix of land-use surrounding the EU including open water, agricultural, residential and highway
*There are 9 occupied structures within the EU and the Zone of Influence
*3400FT of the 10600FT EU perimeter is buffered by woodland or idle land
*There are approximately 97200SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*Predominantly meadow marsh with some areas of fringe marsh
*There is a moderate grade between the open water and the upland

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Open water, upland islands/penninsulas, high marsh, low marsh, shallow pannes, tidal flats
*No evidence of submerged vegetation
*4800FT of the 10600FT EU perimeter is buffered by woodland, idle land OR agricultural land

Water Quality Maintenance

*No Notes

Recreational Potential

*No shellfish beds found
*No signs posted disallowing hunting to occur
*Able to walk-in a canoe from parking before Scammel Bridge, beware of tide

Aesthetic Quality

*Visible land-use is a combination of agriculture, woodland and Rte. 4
*Some visible trash, tires, wood debris, bottles, etc.; limited invasion by phragmites
*Loud noise from Rte. 4 and Spaulding Turnpike as well as heavy air traffic from Pease

Educational Potential

*Limited parking off road before the Scammel Bridge
*Student safety concern due to heavy Rte. 4 traffic and debris hazards; could be avoidable

Noteworthiness

*No Notes

Summary

This system borders Rte. 4 (north side) at the eastern side of Durham near the Scammel Bridge. The system is mainly meadow marsh on its north side, bordered by woodlands and farmland (likely pasture and hay fields). The southside is adjacent to summer camp-like homes and Rte. 4. It is a combination of meadow and narrow fringe marsh. Some Phragmites is encroaching into the area likely caused by freshwater runoff from a paved driveway. This side of the system has a small parking area at Scammel Bridge, but offers a limited view and no access. The northside is open meadow marsh and is essentially in

tact. It is bordered by private hay fields and is completely inaccessible, except possibly for hunting purposes.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*No notes

Acreage of fill deposited on the marsh surface.

*No notes

Existing plant community located on fill.

*No notes

Presence of structures on the fill.

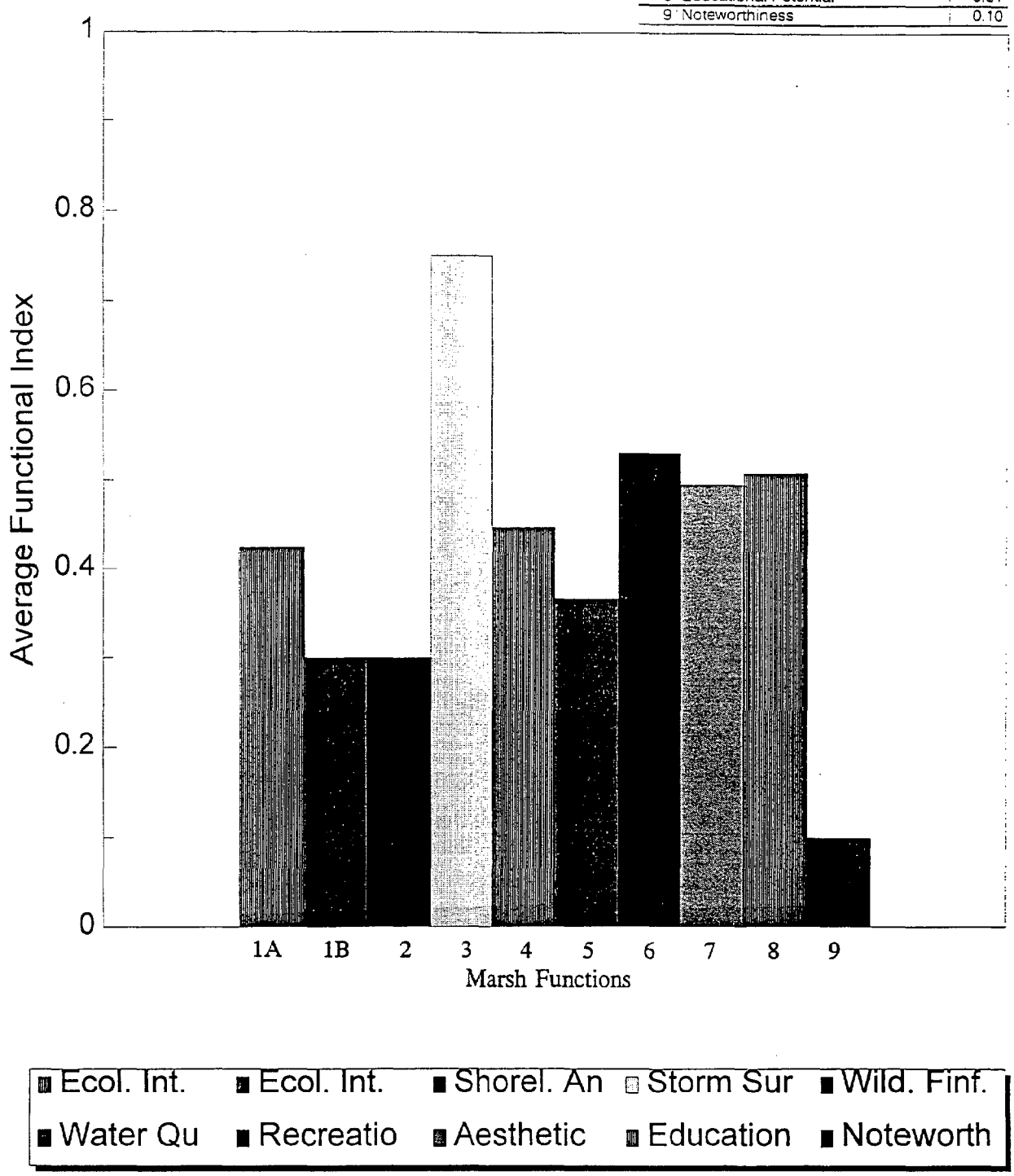
*No notes

Other causes of degradation.

*No notes

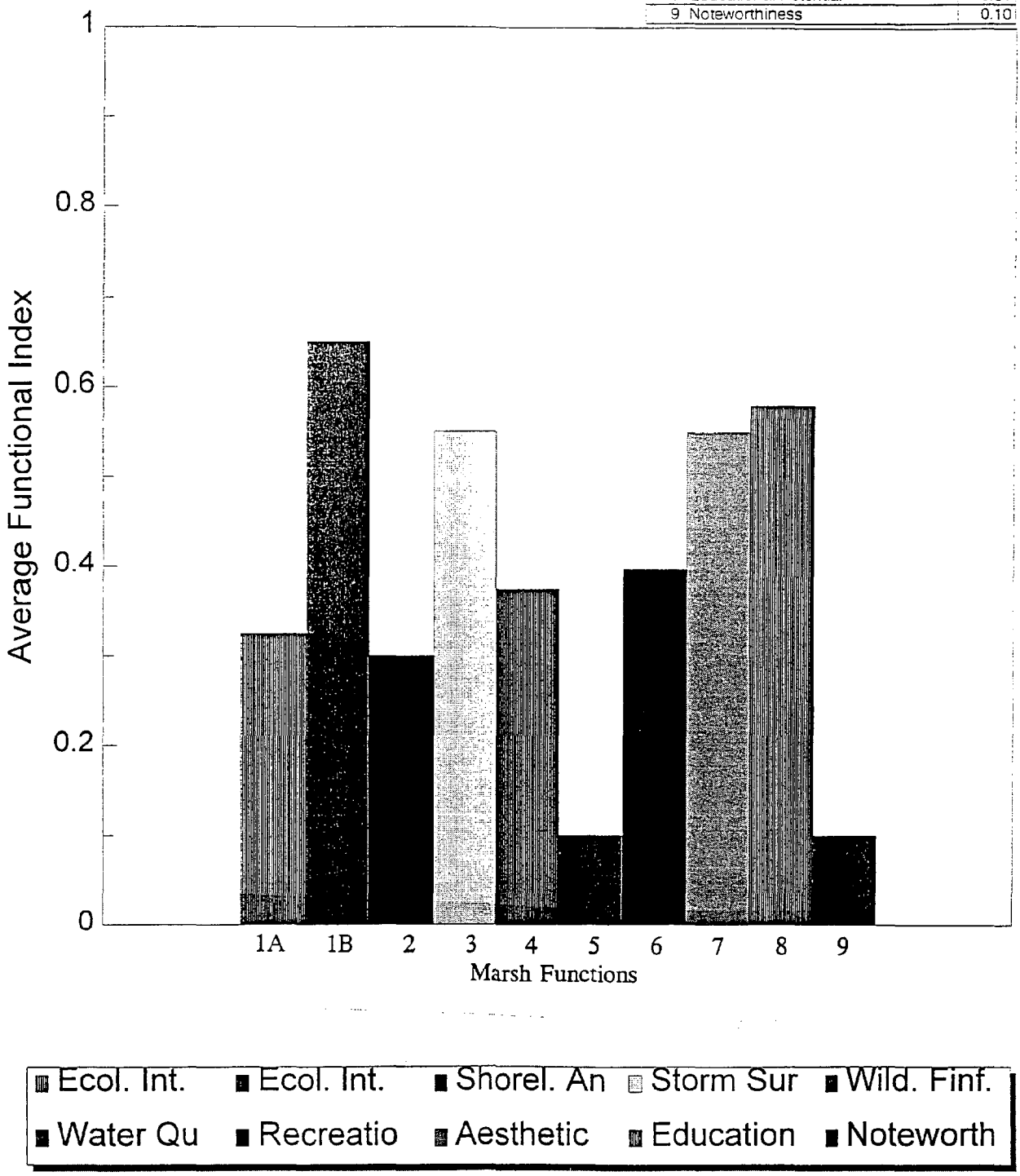
Marsh System 4 EU 1
Average Functional Indices

1A Ecological Integrity Part A	0.43
1B Ecological Integrity Part B	0.30
2 Shoreline Anchoring	0.30
3 Storm Surge Protection	0.75
4 Wildlife, Finfish and Shellfish Habitat	0.45
5 Water Quality Maintenance	0.37
6 Recreational Potential	0.53
7 Aesthetic Quality	0.50
8 Educational Potential	0.51
9 Noteworthiness	0.10



Marsh System 4 EU 2
Average Functional Indices

1A	Ecological Integrity Part A	0.43
1B	Ecological Integrity Part B	0.30
2	Shoreline Anchoring	0.30
3	Storm Surge Protection	0.75
4	Wildlife, Finfish and Shellfish Habitat	0.45
5	Water Quality Maintenance	0.37
6	Recreational Potential	0.53
7	Aesthetic Quality	0.50
8	Educational Potential	0.51
9	Noteworthiness	0.10



MARSH SYSTEM 4

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*No Notes

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*No Notes

Water Quality Maintenance

*No Notes

Recreational Potential

*No Notes

Aesthetic Quality

*No Notes

Educational Potential

*No Notes

Noteworthiness

*No Notes

Summary

The values collected are non-applicable for this evaluation unit because of the state of the EU; which is considered Nontidal.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*There is one tidal restriction for this area that seems to keep all tidal waters out. Possibly a tidal gate below Rte. 108.

Percent of the EU dominated by invasive species.

*All growth (100%) other than tree dominated banks were of Typha species (cattail).

Acreage of fill deposited on the marsh surface.

*Approximately a quarter acre of fill coverage, including a bridge, creates a very restrictive tidal flow, if not total, into the area.

Existing plant community located on fill.

*No notes

Presence of structures on the fill.

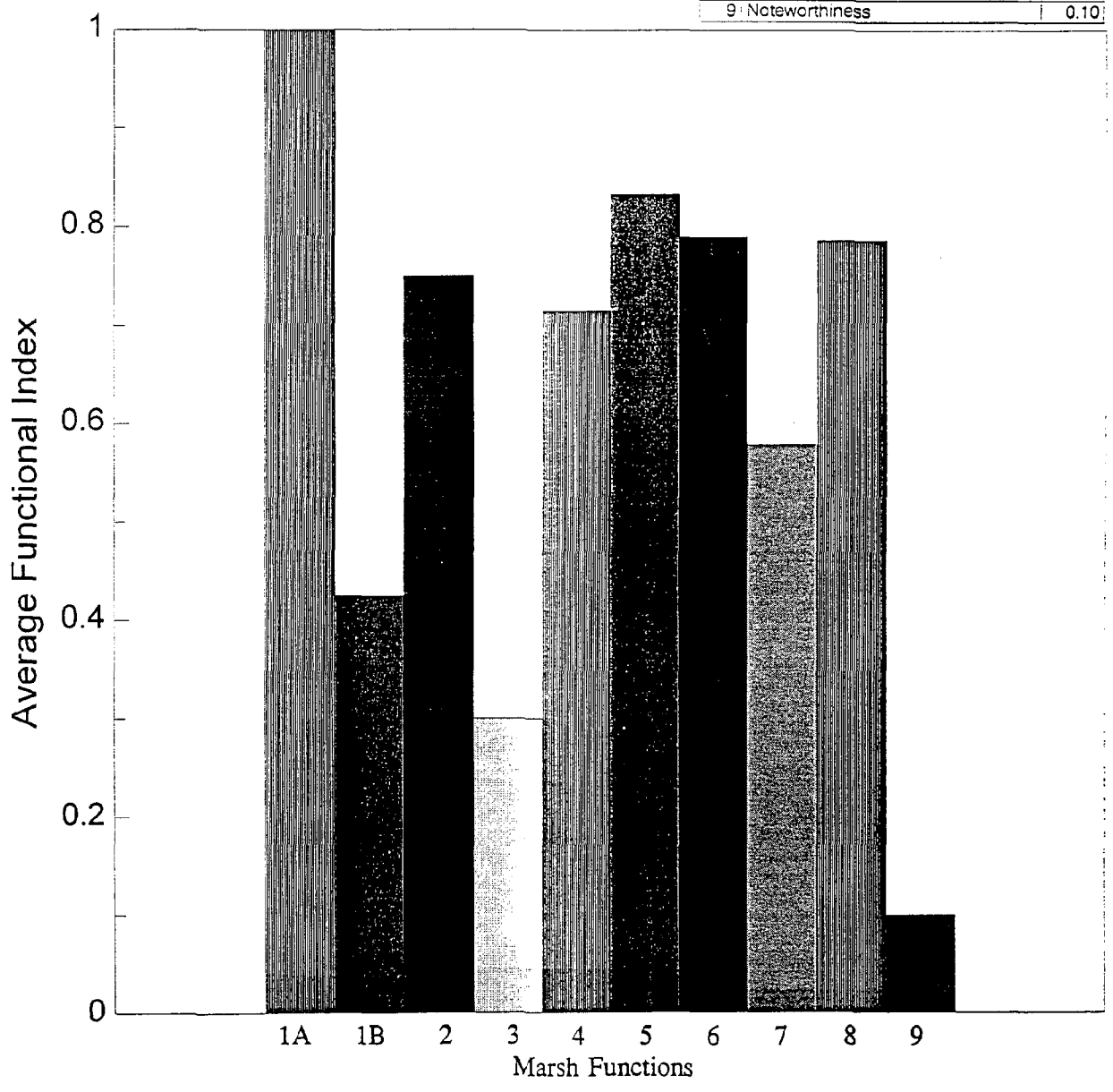
*No notes

Other causes of degradation.

*Area is surrounded by residential units which lie upslope of the bank to the pond. This with the accompanying roads create poor water quality runoff.

Marsh System 5
Average Functional Indices

1A Ecological Integrity Part A	1.00
1B Ecological Integrity Part B	0.43
2 Shoreline Anchoring	0.75
3 Storm Surge Protection	0.30
4 Wildlife, Finfish and Shellfish Habitat	0.71
5 Water Quality Maintenance	0.83
6 Recreational Potential	0.79
7 Aesthetic Quality	0.58
8 Educational Potential	0.79
9 Noteworthiness	0.10



MARSH SYSTEM 5

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*There are 48 occupied structures in the EU and the Zone of Influence
*9000FT of the 18000FT EU perimeter is buffered by woodland or idle land
*There are approximately 35200SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Open water, tidal creek, high marsh, fresh water course, mud flats

Water Quality Maintenance

*No Notes

Recreational Potential

*Boat access from Jackson Landing
*Handicap accessibility (somewhat) from Oyster River Bridge

Aesthetic Quality

*Two primary viewing locations: Jackson Landing and Oyster River Bridge (Rte. 108)
*Visible land-use is predominantly rural residential, potential to be high density on western edge

Educational Potential

*Other Habitats: River, formerly tidal marsh, forest
*Parking at Jackson Landing is safe and accessible

Noteworthiness

*No Notes

Summary

This is a well preserved fringe marsh system that would make an excellent educational site because of boat accessibility and parking. At present the buffer zone is not over developed, but it does have to potential to become too densely populated. Zoning should be checked.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*Much of this EU is a fringe marsh with a large number of mudflats. Most of the land was dominated by Spartina alterniflora and there was a very small and disperse percentage of invasive species (<5%).

Acreage of fill deposited on the marsh surface.

*Two acres of fill for boat launches and parking lots.

Existing plant community located on fill.

*No plant community present.

Presence of structures on the fill.

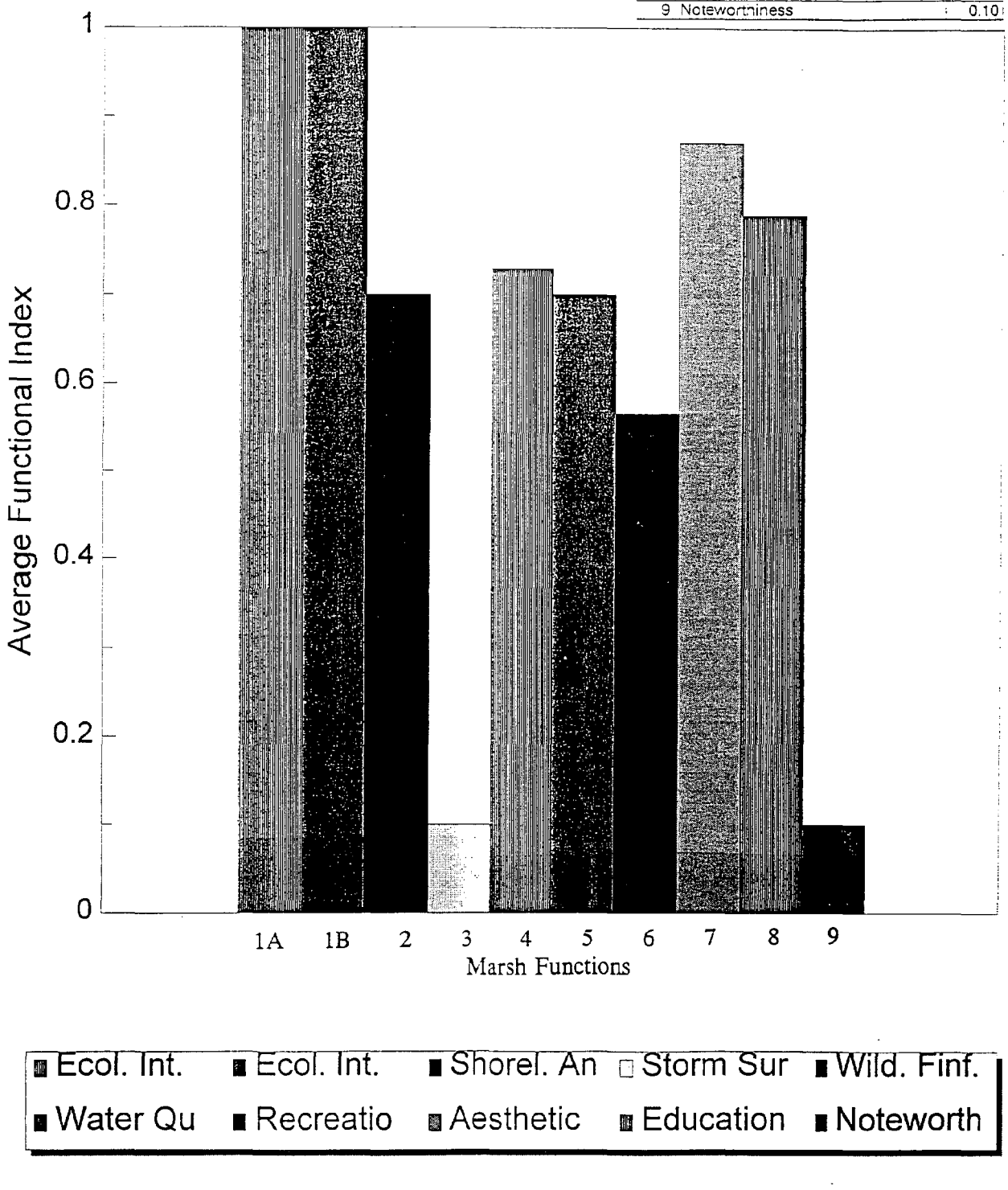
*Boat launch and parking lot.

Other causes of degradation.

*Some invasive plant species due to connections to freshwater systems.

Marsh System 6
Average Functional Indices

1A	Ecological Integrity Part A	1.00
1B	Ecological Integrity Part B	1.00
2	Shoreline Anchoring	0.70
3	Storm Surge Protection	0.10
4	Wildlife, Finfish and Shellfish Habitat	0.73
5	Water Quality Maintenance	0.70
6	Recreational Potential	0.57
7	Aesthetic Quality	0.87
8	Educational Potential	0.79
9	Noteworthiness	0.10



MARSH SYSTEM 6

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Goldenrod, purple loostrife invaded <5% of the plant community
*Land-use in Zone of Influence: forest w/ trees >20FT tall, mowed recreational fields, and agriculture
*One occupied building in the EU and the Zone of Influence
*6000FT of the 6800FT EU perimeter is buffered by woodland or idle land
*There are no paved surfaces within 150FT of the EU

Shoreline Anchoring

*There are a few areas of meadow marsh (by the fresh water source) but it is predominantly fringe marsh
*Mostly a distinct bank with vegetation, approximately 10-15% did not show protective vegetation
*Some erosion in the unvegetated banks

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Open water, high marsh, low marsh, pannes, fresh water source
*Fresh water stream runs from the north and enters the EU near the western edge

Water Quality Maintenance

*No Notes

Recreational Potential

*No hunting posted
*Walk-in access on site (potentially), access also at Jackson Landing <1 mile west

Aesthetic Quality

*Undisturbed and natural appearance
*Moderate noise level from Rte. 4 traffic
*Natural odors only

Educational Potential

*Other habitats: Forest, field, bay, river
*Safe off road parking on site, surrounded by town park, pulling out onto Rte. 4 can be difficult for buses
*Open water is deep, deep hidden pannes in marsh
*Unpaved trails could provide handicap access to marsh edge

Noteworthiness

*Locally historic sight

Summary

This marsh system is pristine. It supports both high and low marsh plant species. It is an excellent example of tidal marshes for recreation and education purposes. Parking is readily available since it is already established as a Town Park. However, traffic on Rte. 4 is heavy and pulling in and out of the site may be difficult. This marsh system should be carefully watched for any degradation which may occur from future Wagon Hill Development and impacts from park visitors.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*None

Percent of the EU dominated by invasive species.

*Less than 5% of the EU is dominated by Golden Rod, Purple Loostrife and some scrub shrub.

Acreage of fill deposited on the marsh surface.

*None

Existing plant community located on fill.

*None

Presence of structures on the fill.

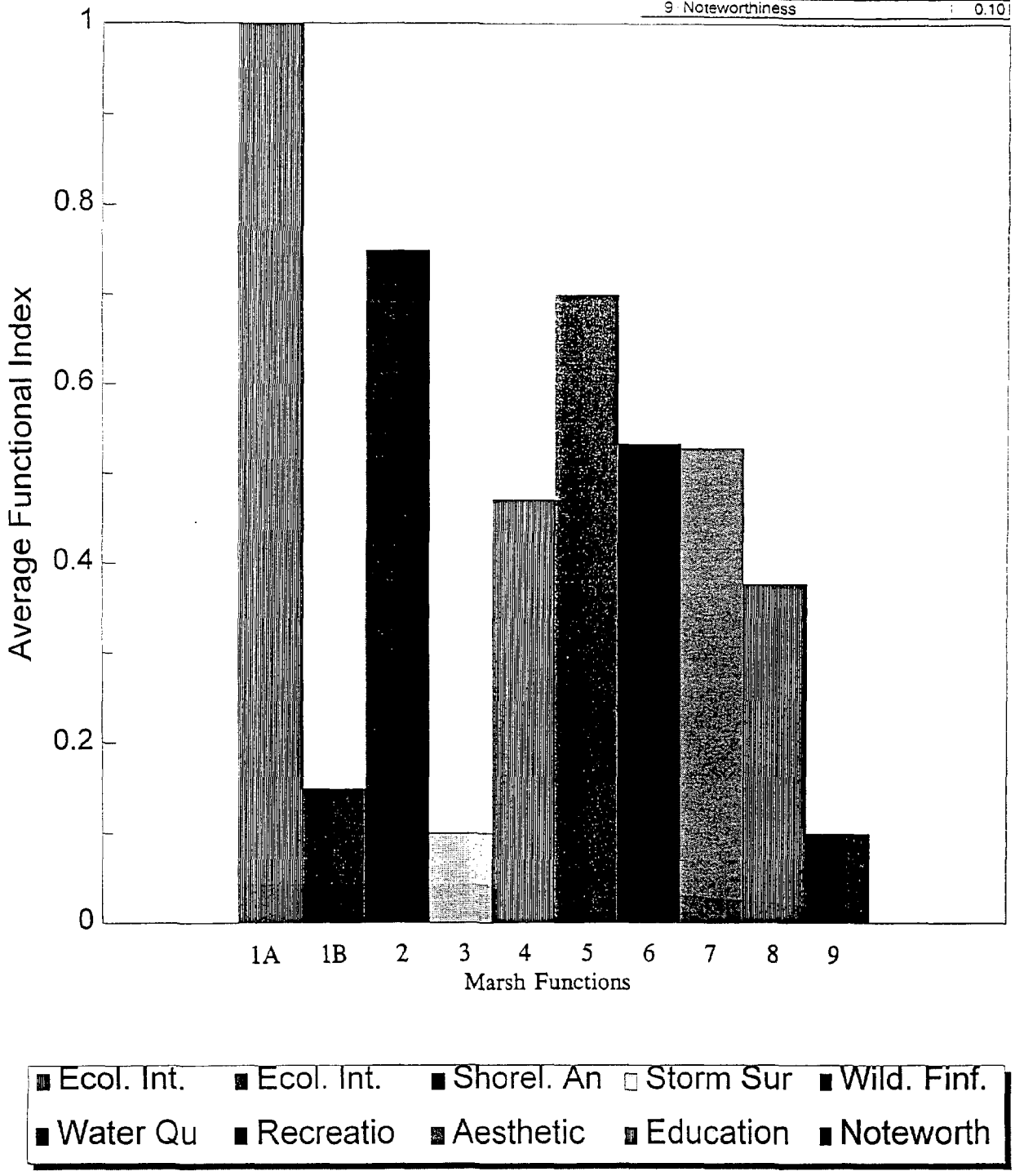
*None

Other causes of degradation.

*No degradation observed.

Marsh System 7
Average Functional Indices

1A Ecological Integrity Part A	1.00
1B Ecological Integrity Part B	0.15
2 Shoreline Anchoring	0.75
3 Storm Surge Protection	0.10
4 Wildlife, Finfish and Shellfish Habitat	0.47
5 Water Quality Maintenance	0.70
6 Recreational Potential	0.53
7 Aesthetic Quality	0.53
8 Educational Potential	0.38
9 Noteworthiness	0.10



MARSH SYSTEM 7

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Land-use in the Zone of Influence contains heavy-use highway and dense residential, <1AC lots
*There are 32 occupied structures within the EU and the Zone of Influence
*600FT of the 4800FT EU perimeter is buffered by woodland or idle land
*There are approximately 61200SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*There is a manmade wall separating the upland from the wetland

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: High marsh, tidal flats, open water, low marsh

Water Quality Maintenance

*No Notes

Recreational Potential

*There is a boat launching area at the end of Cedar Point Rd, limited parking there
*There is a small off road parking area just before the Scammel Bridge, limited access to marsh though

Aesthetic Quality

*Very limited invasive species, marsh was mainly Spartina alterniflora
*There is a lot of trash on most of the marsh, presumably brought in by the tides, big distraction

Educational Potential

*No chance for educational site; all land privately owned and densely populated
*Parking off Scammel Bridge is not safest spot for students, Rte. 4 has heavy traffic

Noteworthiness

*No Notes

Summary

This EU is dominated by Spartina alterniflora. However, it is in very poor condition. The marsh is quite narrow and is always tidally influenced. There is a lot of trash throughout it, we assume most has been brought in with the tides. Most of the area along the eastern half of this EU is developed by a residential community, so it seems that it would be difficult to restore the marsh without having a lot of upset homeowners who want to keep their shoreline private and useable. It could be very good to have a group (students?) to take on the job of cleaning up the trash.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*There really weren't any invasive species there was mainly Spartina alterniflora.

Acreage of fill deposited on the marsh surface.

*No evidence of any fill deposited on the marsh.

Existing plant community located on fill.

*None

Presence of structures on the fill.

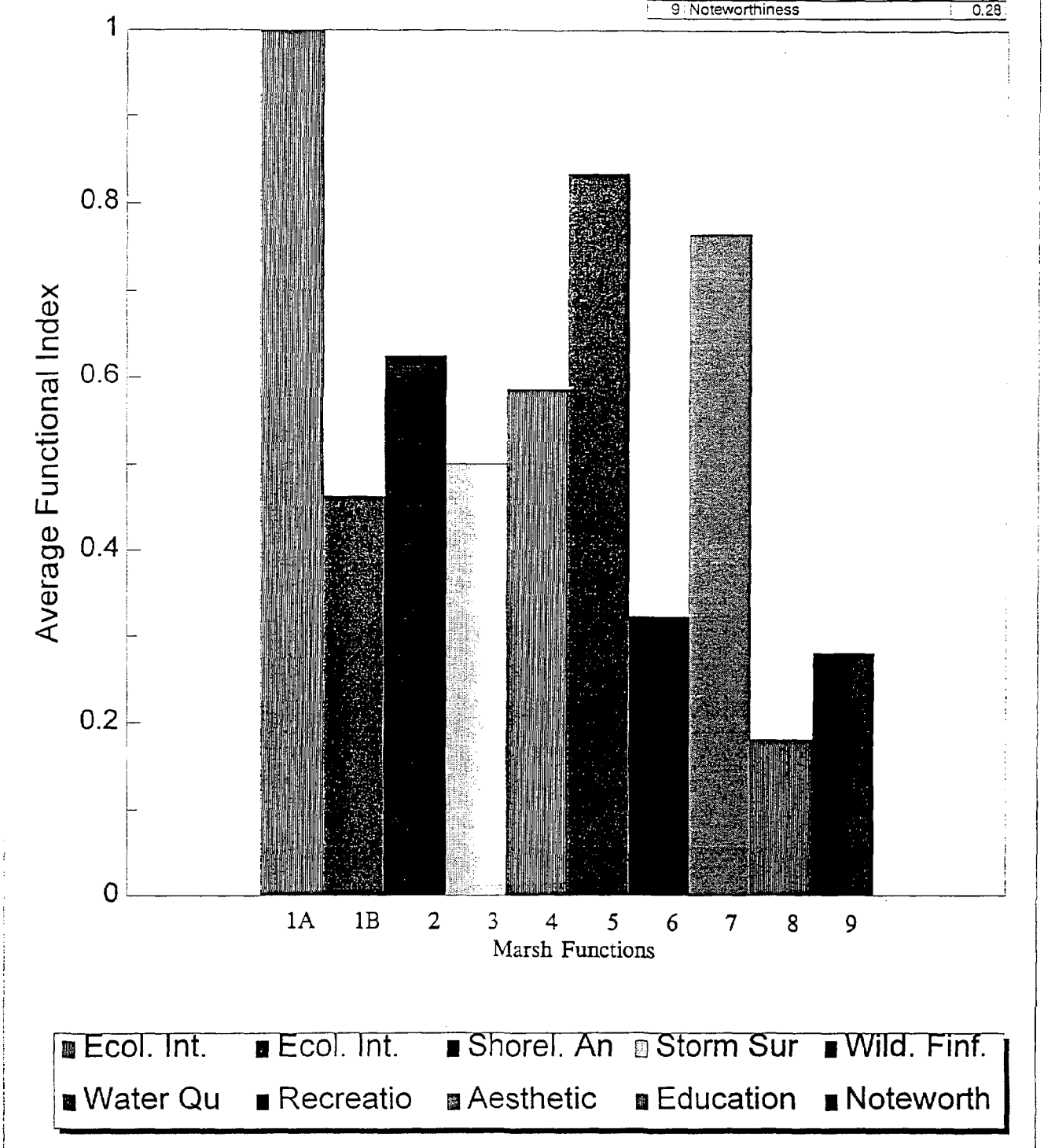
*None

Other causes of degradation.

*There is a lot of trash on most of the wetland, presumably brought in by the tides. There may also be runoff from roads along the marsh. Right now there is hardly any invasion by non-native species, but the plants which are there are having a rough time surviving.

Marsh System 8
Average Functional Indices

1A Ecological Integrity Part A	1.00
1B Ecological Integrity Part B	0.46
2 Shoreline Anchoring	0.63
3 Storm Surge Protection	0.50
4 Wildlife, Finfish and Shellfish Habitat	0.59
5 Water Quality Maintenance	0.83
6 Recreational Potential	0.32
7 Aesthetic Quality	0.76
8 Educational Potential	0.18
9 Noteworthiness	0.28



MARSH SYSTEM 8

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Land-use in the Zone of Influence contains forested land, fields and rural residential use
*There are 3 occupied structures within the EU and the Zone of Influence
*5000FT of the 10600FT EU perimeter is buffered by woodland or idle land
*There is approximately 32400SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*Parts of the EU which bordered the river were fringe marsh, overall the marsh was estuarine meadow
*In some areas there was a distinct bank; in others there none

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: High marsh, low marsh, open water, tidal flats, fresh water source

Water Quality Maintenance

*No Notes

Recreational Potential

*An abundance of ribbed mussels was spotted; does not appear to be a harvested area
*Private boat accesses were spotted
*No off-road public parking available
*No hunting, trapping or fishing signs posted along wooded edges

Aesthetic Quality

*Limited visual detraction by the homes in the area
*Only natural sounds predominate and natural odors only

Educational Potential

*No Notes

Noteworthiness

*No Notes

Summary

Mostly meadow marsh, dominated by Spartina alterniflora and Spartina patens. It is surrounded by river and privately owned land. One lot adjacent to the marsh is presently for sale. No trespassing, hunting, trapping or fishing signs posted along all wooded edges. Access only by surrounding land owners or by small boat.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No tidal restrictions

Percent of the EU dominated by invasive species.

*No invasive species were drawn to our attention. Species composition is mostly Spartina patens and Spartina alterniflora.

Acreage of fill deposited on the marsh surface.

*No fill on any marsh surface was apparent to us.

Existing plant community located on fill.

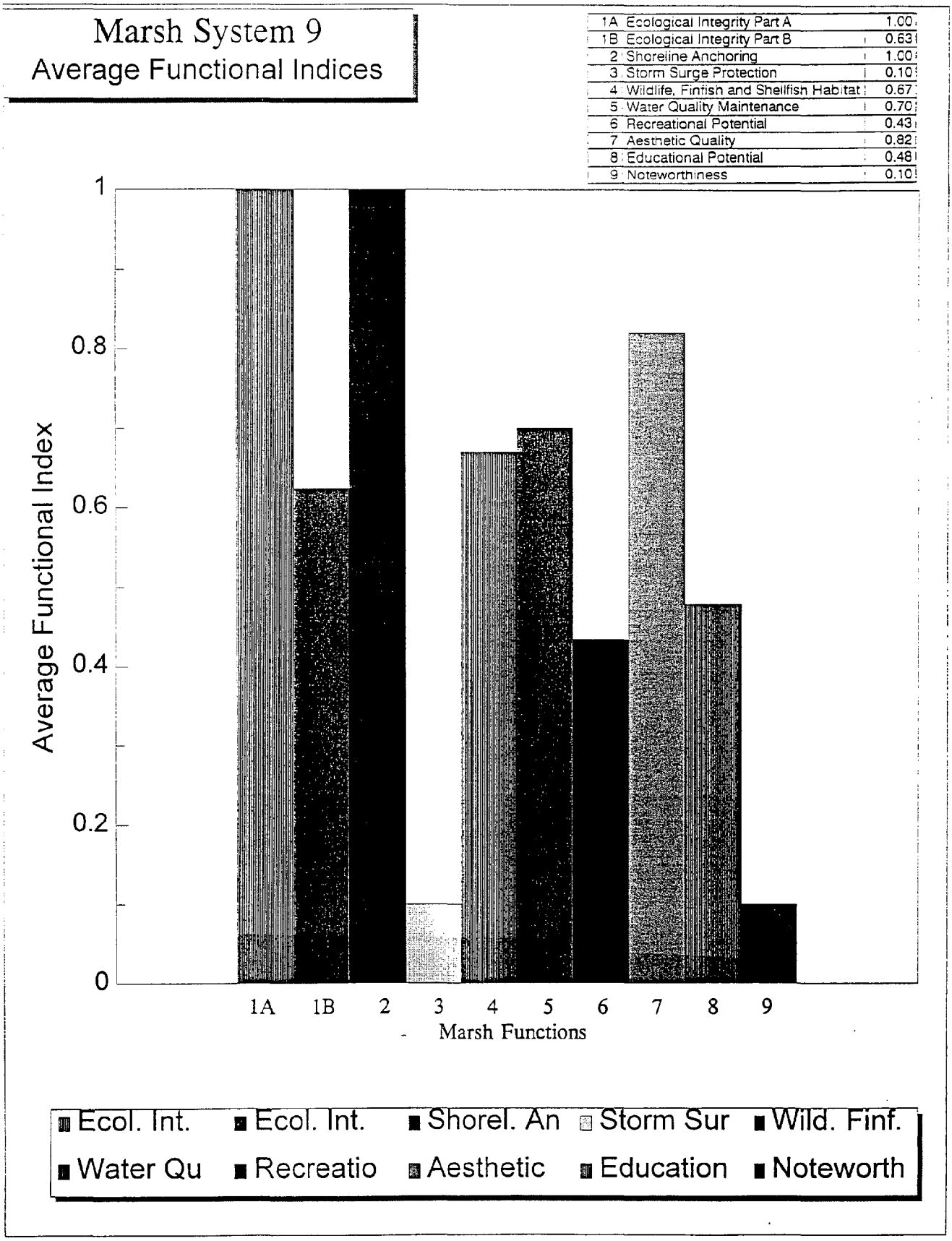
*None

Presence of structures on the fill.

*None

Other causes of degradation.

*Homeowners are storing boats on the marsh itself.


Marsh System 9
Average Functional Indices
1A Ecological Integrity Part A 1.00
1B Ecological Integrity Part B 0.63
2 Shoreline Anchoring 1.00
3 Storm Surge Protection 0.10
4 Wildlife, Finfish and Shellfish Habitat 0.67
5 Water Quality Maintenance 0.70
6 Recreational Potential 0.43
7 Aesthetic Quality 0.82
8 Educational Potential 0.48
9 Noteworthiness 0.10
Average Functional Index
1
0.8
0.6
0.4
0.2
0
1A 1B 2 3 4 5 6 7 8 9
Marsh Functions
Ecol. Int.
Ecol. Int.
Shorel. An
Storm Sur
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Recreatio
Aesthetic
Education
Noteworth

MARSH SYSTEM 9

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Dominant land-use in the Zone of Influence is agricultural and rural residential lots
*There are 17 occupied structures in the EU and the Zone of Influence
*1000FT of the 8200FT EU perimeter is buffered by woodland or idle land

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Open water, low marsh, mud flats

Water Quality Maintenance

*No Notes

Recreational Potential

*No Notes

Aesthetic Quality

*Visual disturbances are location specific, residential development expected to increase

Educational Potential

*Other habitats: River, forest, bay

Noteworthiness

*No Notes

Summary

No Notes

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No tidal restrictions

Percent of the EU dominated by invasive species.

*Species Typha is present, but in negligible numbers (<5%). No area is 'dominated' by any invasive species.

Acreage of fill deposited on the marsh surface.

*No fill observed on the marsh surface.

Existing plant community located on fill.

*None

Presence of structures on the fill.

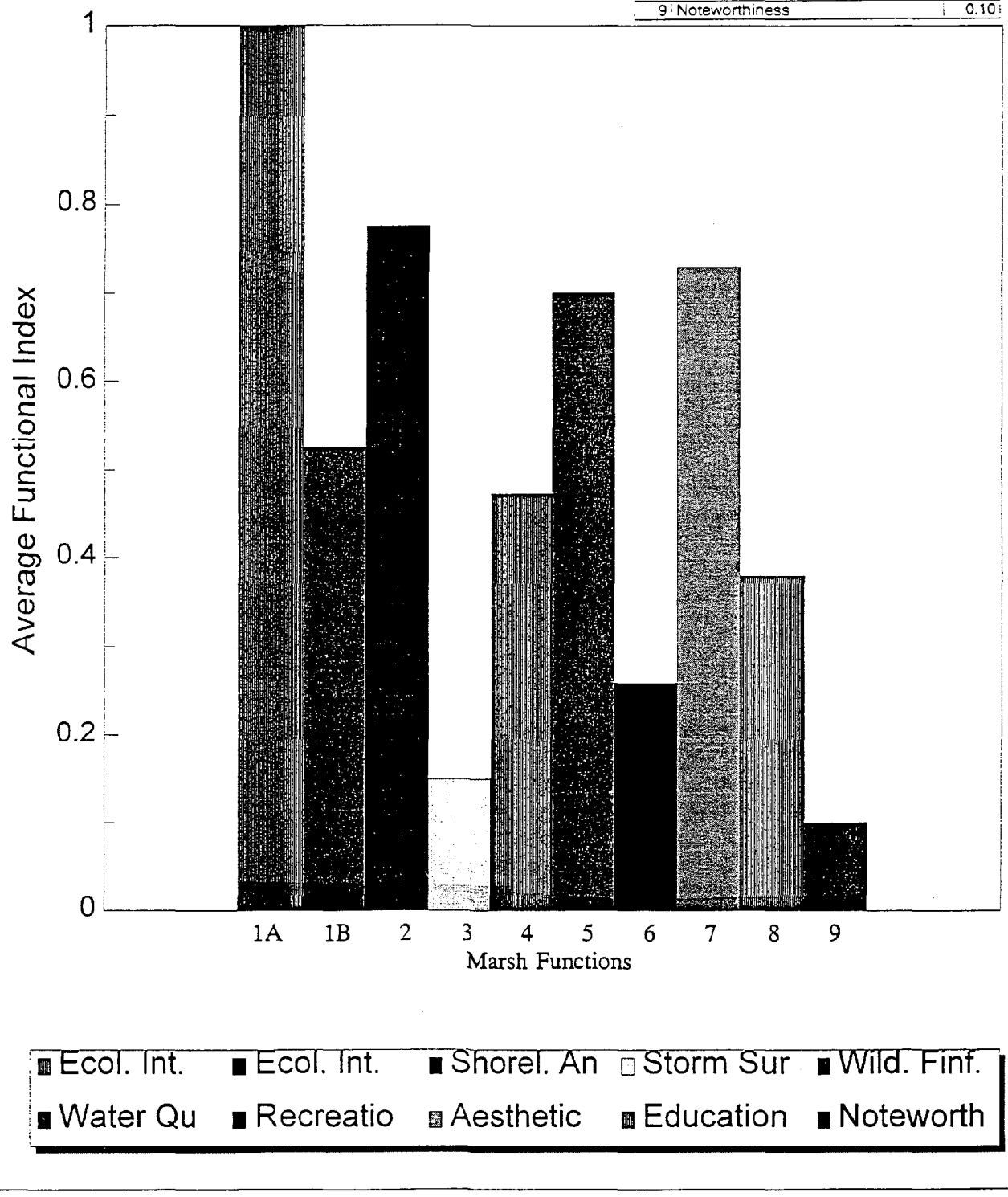
*None

Other causes of degradation.

*Possible effects from the wastewater treatment plant upstream. Currently there is a moderate amount of housing, however there is a lot of home lots for sale and development is expected to increase.

Marsh System 10
Average Functional Indices

1A	Ecological Integrity Part A	1.00
1B	Ecological Integrity Part B	0.53
2	Shoreline Anchoring	0.78
3	Storm Surge Protection	0.15
4	Wildlife, Finfish and Shellfish Habitat	0.47
5	Water Quality Maintenance	0.70
6	Recreational Potential	0.26
7	Aesthetic Quality	0.73
8	Educational Potential	0.38
9	Noteworthiness	0.10



MARSH SYSTEM 10

EVALUATOR'S FILED NOTES AND SUMMARY

Ecological Integrity

*Land-use dominant in the Zone of Influence include rural residential, forested and a buffalo farm
*There are 10 occupied structures within the EU and the Zone of Influence
*600FT of the 1600FT EU perimeter is buffered by woodland or idle land
*There are approximately 20400SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*There is a combination of both meadow and fringe marsh in the EU
*Distinct bank evident in some areas, none in others; erosion was seen

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: High marsh, low marsh, open water, tidal flats, shallow pannes, tidal creek
*1600FT of the 4200FT EU perimeter is buffered by woodland, idle, or agricultural land

Water Quality Maintenance

*No Notes

Recreational Potential

*Posted No Hunting
*Boat access from Adam's Point, >1 mile south
*Land is private residences and a buffalo farm; off road public parking is not easy
*No handicap access, no maintained trails, board walks or visitors center present

Aesthetic Quality

*Dominant land-use surrounding the EU is a combination of residential and agricultural land
*Trash is a major visual detractor: rusty nails, bricks, wood debris, broken glass, 3 private piers
*Moderate noise levels from frequent airplane and motor boat traffic

Educational Potential

*Other habitats: Buffalo farm, agriculture, bay
*No suitable parking for school vehicles
*Trash such as nails, glass, bricks and loose embankments pose student safety hazards

Noteworthiness

*No Notes

Summary

Probably one of the quietest areas in Durham. If permission could be obtained, this would be a great education site. Safe for students, no heavily traveled roads in the area. The appearance of the shoreline is, however, very dirty.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*No notes

Acreage of fill deposited on the marsh surface.

*No notes

Existing plant community located on fill.

*No notes

Presence of structures on the fill.

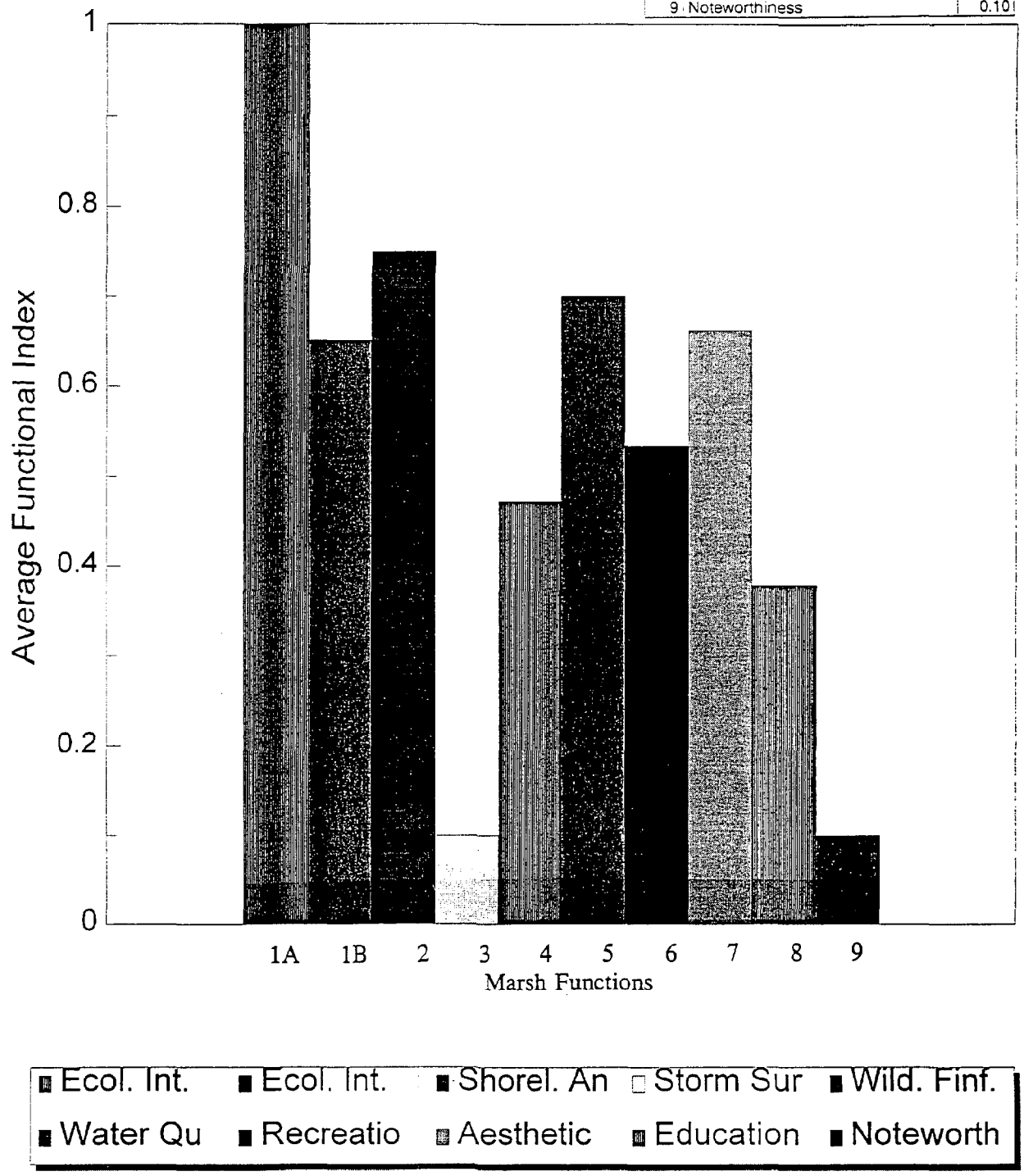
*No notes

Other causes of degradation.

*No notes

Marsh System 11
Average Functional Indices

1A Ecological Integrity Part A	1.00
1B Ecological Integrity Part B	0.65
2 Shoreline Anchoring	0.75
3 Storm Surge Protection	0.10
4 Wildlife, Finfish and Shellfish Habitat	0.47
5 Water Quality Maintenance	0.70
6 Recreational Potential	0.53
7 Aesthetic Quality	0.66
8 Educational Potential	0.38
9 Noteworthiness	0.10



MARSH SYSTEM 11

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Northern section was more densely populated than the southern
*There are 18 occupied structrues within the EU and the Zone of Influence
*1200FT of the 8000FT EU perimeter is buffered by woodland or idle land
*There is approximately 21600SF of paved surfaces within 150FT of EU

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: Open water, tidal flats, high marsh, low marsh, upland islands and peninsulas
*2400FT of the 8000FT EU perimeter is buffered by woodland, idle, or agricultural land

Water Quality Maintenance

*No Notes

Recreational Potential

*According to NHF&G from the cable crossing south to EU border is an approved and open shellfish area
*No evidence of hunting, mostly private property with No Trespassing signs posted
*It appeared that each property had its own private dock with boats or canoes
*Only public access is from Adam's Point, ~1/2 mile south

Aesthetic Quality

*Area is predominantly residential, there was some traffic producing moderate noise
*Natural odors only; you could smell the low tide

Educational Potential

*Other habitats: Bay, field, forest
*Adequate parking for school vehicles not found here

Noteworthiness

*There were many old homes within the EU, but none were historically registered

Summary

Mostly privately owned shoreline homes, marsh access is very difficult.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No notes

Percent of the EU dominated by invasive species.

*No notes

Acreage of fill deposited on the marsh surface.

*No notes

Existing plant community located on fill.

*No notes

Presence of structures on the fill.

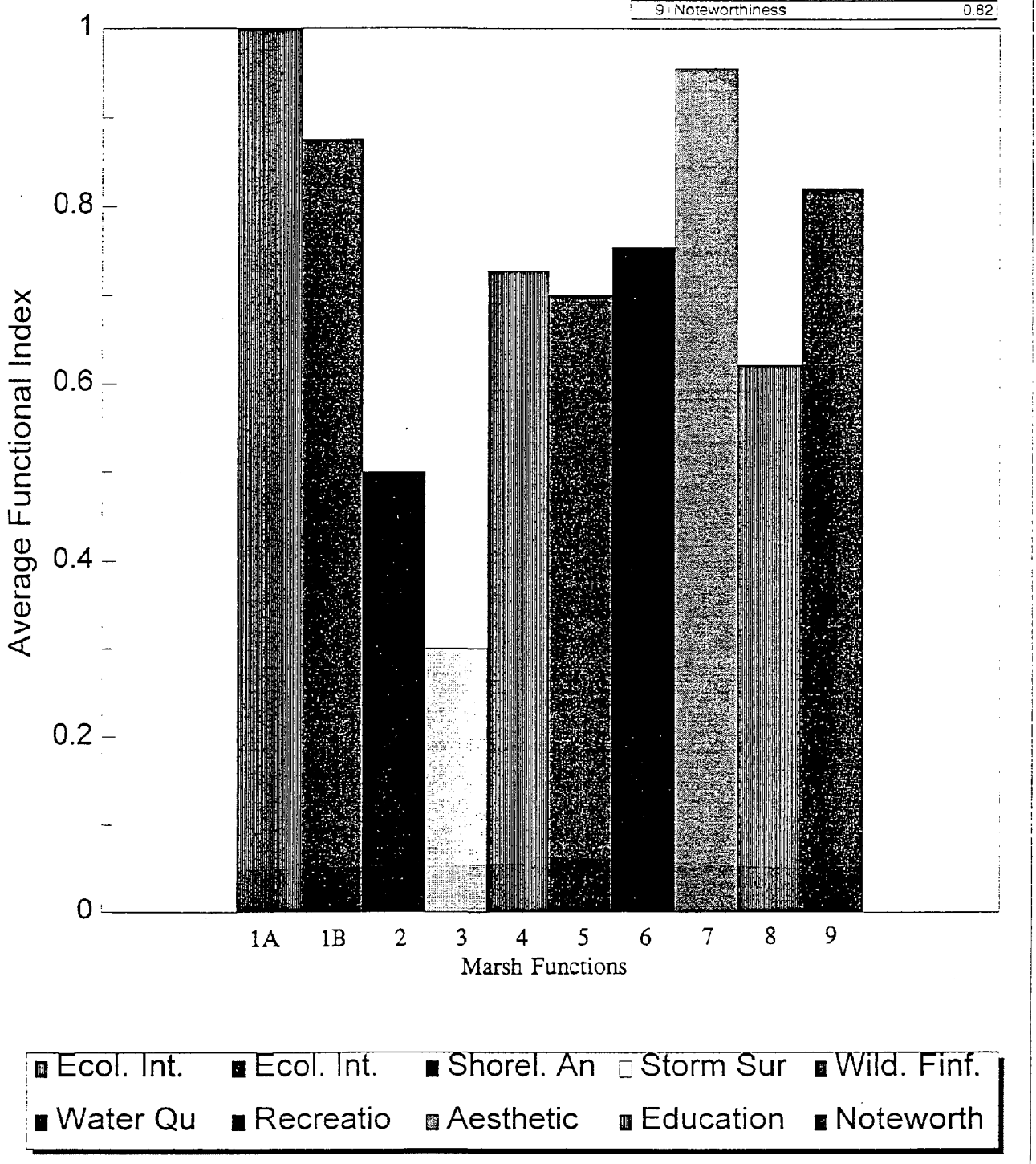
*No notes

Other causes of degradation.

*No notes

Marsh System 12
Average Functional Indices

1A	Ecological Integrity Part A	1.00
1B	Ecological Integrity Part B	0.88
2	Shoreline Anchoring	0.50
3	Storm Surge Protection	0.30
4	Wildlife, Finfish and Shellfish Habitat	0.73
5	Water Quality Maintenance	0.70
6	Recreational Potential	0.75
7	Aesthetic Quality	0.95
8	Educational Potential	0.62
9	Noteworthiness	0.82



MARSH SYSTEM 12

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*A very small (<5%) number of invasive species were noted at the most north-west part of the EU
*There are 0 occupied structures within the EU and the Zone of Influence
*1400FT of the 5000FT EU perimeter is buffered by woodland or idle land
*There are no paved surfaces within 150FT of the EU
*Two pipe point sources were discovered in the north eastern section

Shoreline Anchoring

*No Notes

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: High marsh, low marsh, open water, mud flat, tidal creek, fresh water source
*3200FT of the 5000FT EU perimeter is buffered by woodland, idle or agricultural land

Water Quality Maintenance

*No Notes

Recreational Potential

*No Hunting signs posted along roads and Jackson Lab property; spent shells were found in the area
*Parking and boat access from Adam's Point, <1/2 mile south
*Trails do exist, they are clear but not advisable for handicap access, it is not apparent if they are regularly maintained or not

Aesthetic Quality

*No Notes

Educational Potential

*Other habitats: Bay, field, forest, ocean
*Suitable school vehicle parking at Adam's Point, ~10 minute walk to EU

Noteworthiness

*EU is a USFWS Wildlife management area

Summary

This appears to be an essentially healthy marsh. No signs of plant or wildlife degradation is observed other than from the presence of a 100 foot stone wall at the north west end of the marsh system. The wall does not appear to restrict flow, in fact it appears as if the tide is breaking the wall down. Some wildlife species seen are herring gulls, blue heron and several unknown fish species in pannes. Some wreck containing trash was found, however, this is caused by tidal action and did not appear to degrade the system.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*No tidal restrictions as defined by the Coastal Method were found. The stone wall, mentioned above, does exist but does not appear to restrict tidal flow.

Percent of the EU dominated by invasive species.

*Less than 5% of EU is dominated by invasive species. They are found at the upper end of the creek where the salt marsh grades into the upland.

Acreage of fill deposited on the marsh surface.

*No fill appears to be deposited on the marsh.

Existing plant community located on fill.

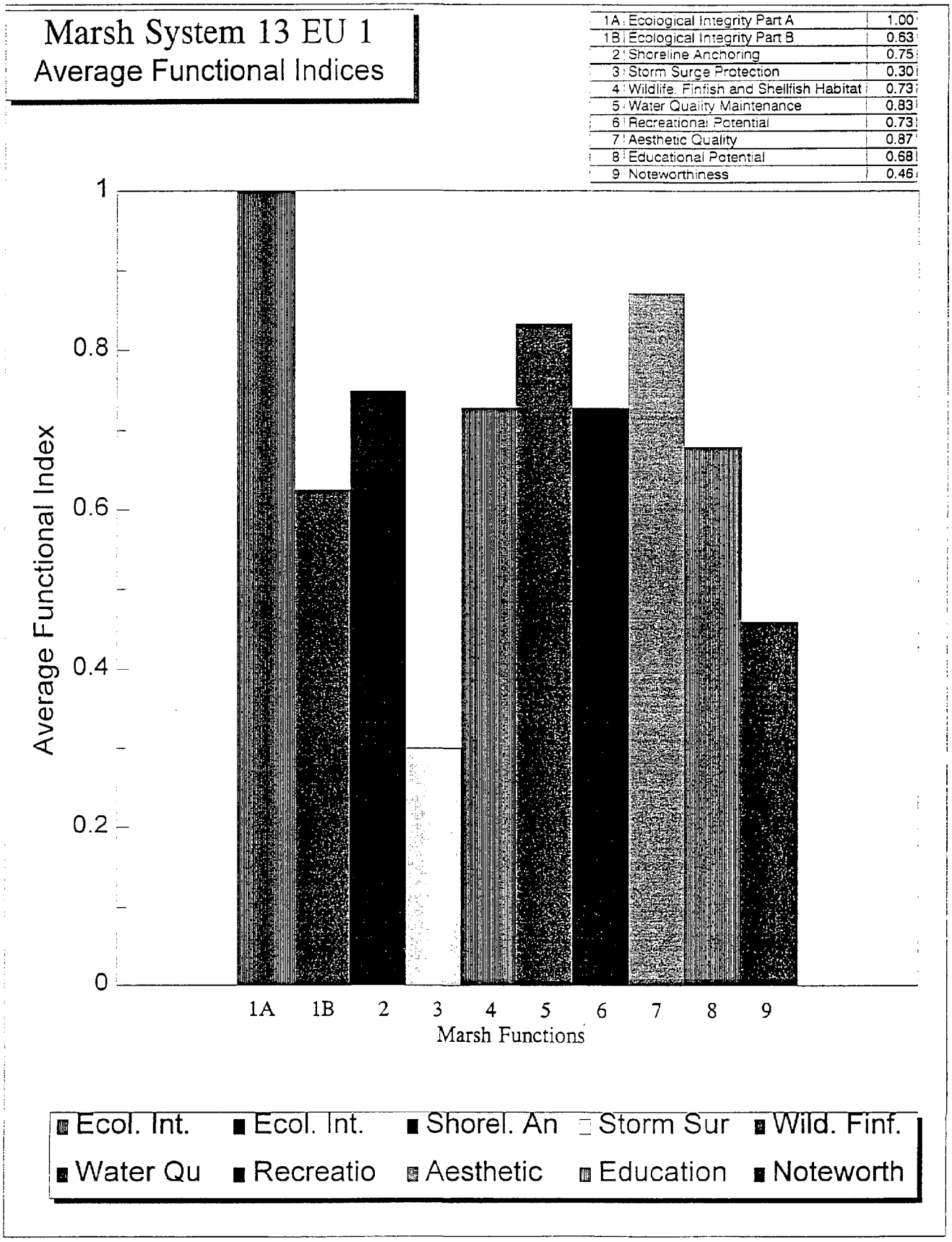
*No fill

Presence of structures on the fill.

*None

Other causes of degradation.

*Two pipes ere found on the north/eastern side of the tidal creek. Both pipes were about 100 feet long and extended across the marsh into the upland. Both pipes were apparently put there a long time ago and their purpose is unknown. One pipe is broken where it enters the creek, a white odorless fluid was flowing out of it. The other pipe didn't seem to give off any odors, neither pipe affected the plant life around them. Both pipes were buried in about 1 to 2 feet of salt marsh and can only be seen because the tide has caused some erosion around them. Neither pipe seemed to degrade the area.


Marsh System 13 EU 1
Average Functional Indices
1A Ecological Integrity Part A 1.00
1B Ecological Integrity Part B 0.63
2 Shoreline Anchoring 0.75
3 Storm Surge Protection 0.30
4 Wildlife, Finfish and Shellfish Habitat 0.73
5 Water Quality Maintenance 0.83
6 Recreational Potential 0.73
7 Aesthetic Quality 0.87
8 Educational Potential 0.68
9 Noteworthiness 0.46
Average Functional Index
1
0.8
0.6
0.4
0.2
0
1A 1B 2 3 4 5 6 7 8 9
Marsh Functions
Ecol. Int.
Ecol. Int.
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Recreatio
Aesthetic
Education
Noteworth

MARSH SYSTEM 13 EVALUATION UNIT 1

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Land-use is a mix of open space and rural residential
*There are 12 occupied structures within the EU and the Zone of Influence
*10000FT of the 19600FT EU perimeter is buffered by woodland or idle land
*There is approximately 43200SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*Marsh dominated by S. alterniflora, not a high energy system...some plant life did not appear healthy
*Generally a steep distinct bank

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: High marsh, low marsh, open water, tidal creek, upland islands/penninsulas, mud flats, fresh water source
*No presence of submerged vegetation, saw mostly mud
*13200FT of the 19600FT EU perimeter is buffered by woodland, idle, or agricultural land
*Marsh is connected to Crommet Creek

Water Quality Maintenance

*No Notes

Recreational Potential

*Boat access at Adam's Point
*Handicap access is visual from road
*Jackson Lab is at site, but it doesn't house a "visitors center"

Aesthetic Quality

*Primary viewing from Durham Point Road bridge

Educational Potential

*Other habitats: Forest, bay
*Suitable off road parking at Adam's Point, >20 minute walk to primary viewing location
*No visible student safety hazards

Noteworthiness

*Sightings of Great Blue Heron

Summary

The area that parallels Durham Point Road was largely inaccessible due to steep cliffs and only a few residences. Only a few places were field checked. The best access is probably by boat. The road which connects Adams Point could be considered a tidal restriction of sorts, however, this location is extremely important for the Jackson Marine Laboratory.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*The road built for the Jackson Lab borders the system and separates it form adjacent marsh and exposure to the coast. If the road were not there it appears that the bay would flow directly into the marsh system, instead of having to flow around Adams Point. However, for this evaluation, the road was not considered a true tidal restriction.

Percent of the EU dominated by invasive species.

*We did not detect any invasive species in the EU. The time of year may detract from out ability to do so.

Acreage of fill deposited on the marsh surface.

*The marsh appears to have been at least slightly filled for the construction of the road to Jackson Lab, and the boat landing established there. We estimate that approximate that one third (1/3) of an acre of fill was deposited.

Existing plant community located on fill.

*There is no plant life because it is covered in pavement.

Presence of structures on the fill.

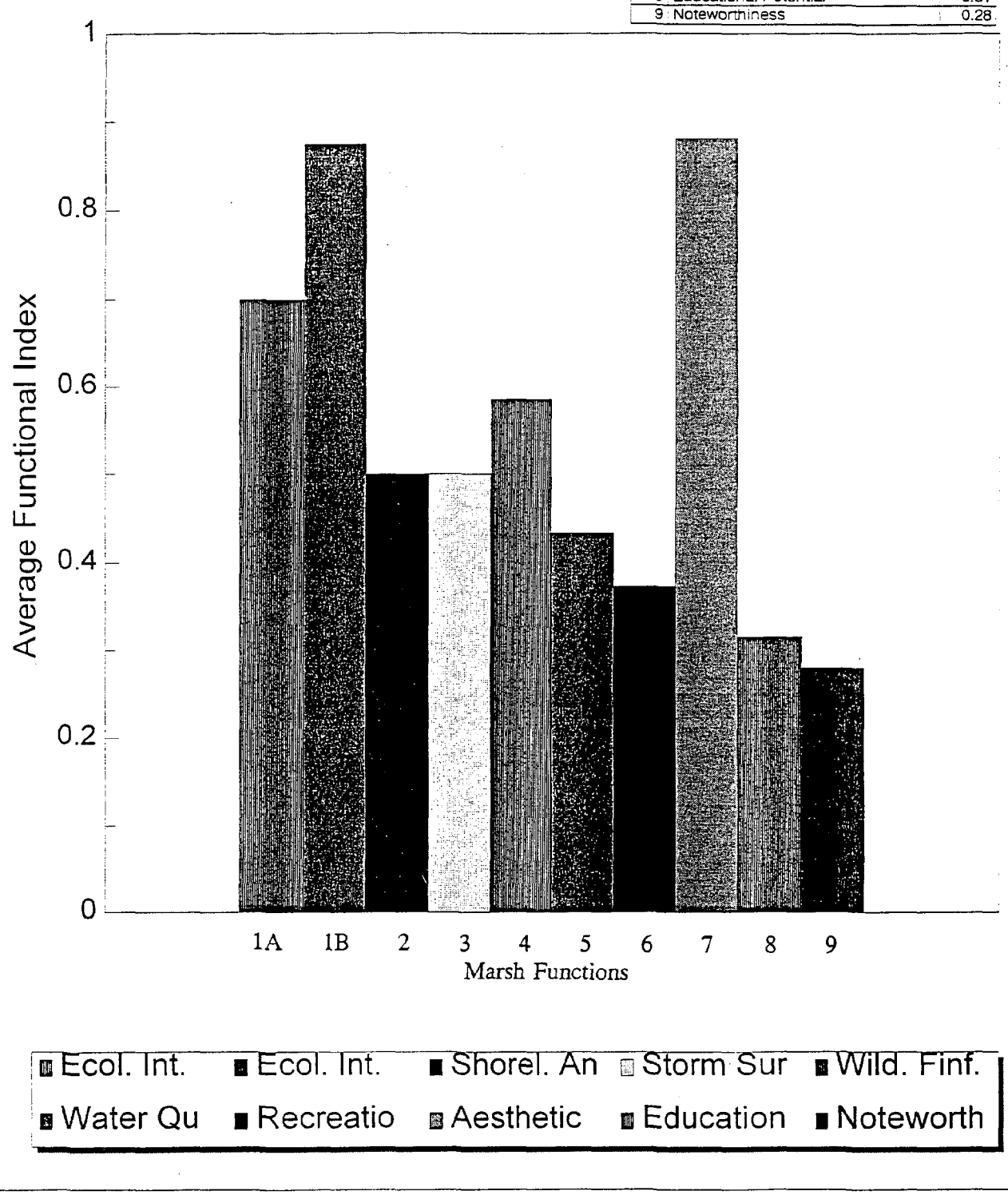
*The fill is covered by pavement - a road and a boat landing.

Other causes of degradation.

*No notes

Marsh System 13 EU 2
Average Functional Indices

1A. Ecological Integrity Part A	0.70
1B. Ecological Integrity Part B	0.88
2. Shoreline Anchoring	0.50
3. Storm Surge Protection	0.50
4. Wildlife, Finfish and Shellfish Habitat	0.59
5. Water Quality Maintenance	0.43
6. Recreational Potential	0.37
7. Aesthetic Quality	0.88
8. Educational Potential	0.31
9. Noteworthiness	0.28



MARSH SYSTEM 13 EVALUATION UNIT 2

EVALUATOR'S FIELD NOTES AND SUMMARY

Ecological Integrity

*Dominant land-use in the Zone of Influence is forest, fields and open space
*There are 0 occupied structures within the EU and the Zone of Influence
*3200FT of the 6000FT EU perimeter is buffered by woodland or idle land
*There are 10800SF of paved surfaces within 150FT of the EU

Shoreline Anchoring

*Sighted an abundance of S. alterniflora, but it was cut off from wave energy

Storm Surge Protection

*No Notes

Wildlife, Finfish and Shellfish Habitat

*Habitat types: High marsh, low marsh, tidal creek, fresh water source
*Marsh is connected to a fresh water source; Crommet Creek

Water Quality Maintenance

*No Notes

Recreational Potential

*Site is canoeable, during high tide only
*No handicap access

Aesthetic Quality

*EU appears natural and undisturbed
*Natural sounds and natural odors

Educational Potential

*Other habitats: Forest, fresh water
*No good parking for school vehicles

Noteworthiness

*Blue heron have been sighted here

Summary

This very small segment of tidal meadow marsh was not easily accessible, except by foot over private property, so it would probably not make a very good educational site. However, the presence of the bridge across the EU, Durham Point Road, provides an illustration of the effects of tidal restrictions. This marsh is quiet and otherwise undisturbed. Perhaps one recommendation for restoration purposes would be the reduction of fill on the marsh surface, but it may already be too late.

DESCRIPTION OF RESTORATION POTENTIAL

Number and type of restrictions between EU and free tidal flow.

*The Durham Point Road separates EU 1 from EU2. A bridge was built across the marsh, and it appears to block some tides from thru flow. It looks as if part of the marsh might have been filled to support the bridge.

Percent of the EU dominated by invasive species.

*We did not detect the presence of invasive species in the marsh. Perhaps due to the time of year the study was done. Our estimate of <5% dominated by invasive species may be a bit too low.

Acreage of fill deposited on the marsh surface.

*As mentioned above, some fill may have been placed on the surface of the marsh to support the Durham Point Road bridge. If fill was used, it appears to be <1 acre.

Existing plant community located on fill.

*The fill that may have been placed on the marsh for the road consists mostly of large rocks and boulders. Some grasses (foreign to salt marshes) were growing sparsely among them. The fill did not appear to be dominated by marsh species.

Presence of structures on the fill.

*The fill was allegedly placed on the marsh for the road that crosses it (Durham Point Road).

Other causes of degradation.

*No notes

(4) Results of the Coastal Method Management Options Matrix.

The Coastal Method Manual provides a general framework in which appropriate management and planning decisions can be made based on a combination of AFI scores across various functions. The criteria for each of five management options are listed in the matrix below, Figure 2. Searches were performed on the data base in order to list the Marsh Systems which would fall into Options A through E. The results of that query and an explanation of Management Options A through E are addressed in this section.

Steps to the Coastal Method Management Options

Some functions are based on the size and type of marsh, such is the case for Storm Surge Protection and Shoreline Anchoring. Therefore, neither can be improved by management of the marsh. However, the marshes ability to continue providing these functions is important for the protection of the surrounding upland and therefore should be included in the evaluation process.

The AFIs for Ecological Integrity (Parts A and B), on the other hand, indicate the effects of human influence on the Evaluation Unit, and therefore implementation of a management plan can improve the functional capacity for these and other functions. With this in mind, the following steps or queries are outlined in the Coastal Method to be used in choosing one of the five management options for Marsh Evaluation Units. (See Summary Tables for a count of the high and low scores on each function.

(1) Review the AFIs for Ecological Integrity:

Part A. High scores (>0.6) in Ecological Integrity, Part A, indicate the EU is receiving adequate tidal flushing and supporting a natural tidal marsh community; Low scores ($<=0.6$) indicate a problem with tidal flow which can lead to a degraded EU.

Results of the Query:

- ***Fifteen of the 17 EUs have Ecological Integrity AFIs of greater than 0.6.***
- ***System 4 (both EUs) scored below 0.6 on this function.***

Part B. High scores in Ecological Integrity, Part B, indicate the 500 foot Zone of Influence surrounding area of the EU is relatively undisturbed and provides the marsh with some protection against the impacts of human development. Low scores here indicate extensive development around the EU which can lower the value of the marsh for several other functions.

Results of the Query:

- ***Eight EUs have AFIs greater than 0.6; EUs 1.2, 4.2, 6.1, 9.1, 11.1, 12.1, 13.1, 13.2.***
- ***Nine have AFIs less than or equal to 0.6; EUs 1.1, 2.1, 2.2, 3.1, 4.1, 5.1, 7.1, 8.1. 10.1.***

(2) Review of the AFIs for Wildlife Habitat, Water Quality Maintenance, and Aesthetic Quality:

Results of the Queries:

Wildlife Habitat:

- ***Eight EUs have AFIs greater than 0.6; EU 1.1, 1.2, 2.2, 5.1, 6.1, 9.1, 12.1, 13.1.***
- ***Nine EU's have AFIs less than or equal to 0.6; EU 2.1, 3.1, 4.1, 4.2, 7.1, 8.1, 10.1, 11.1, 13.2.***

Water Quality Maintenance:

- ***Twelve EUs have AFIs greater than 0.6; EU 1.1, 2.1, 3.1, 5.1, 6.1, 7.1, 8.1. 9.1, 10.1, 11.1, 12.1, 13.1***
- ***Five EUs have AFIs less than or equal to 0.6; EU 1.2, 2.2, 4.1, 4.2, 13.2.***

Aesthetic Quality:

- ***Eleven EUs have AFIs greater than 0.6; EUs 1.1, 1.2, 3.1, 6.1, 7.1, 8.1, 9.1, 10.1, 11.1, 12.1, 13.1, 13.2***
- ***Six EUs have AFIs less than or equal to 0.6; EU 2.1, 2.2, 4.1, 4.2, 5.1, 7.1.***

(3) A review of the Evaluation Units which fall into the Options categories by the criteria listed in the Management Options Matrix.

Figure 2. Evaluation Unit Management Option Matrix

OPTION A	OPTION B	OPTION C	OPTION D	OPTION E
High Ecological Integrity Part A	High Ecological Integrity Part A	Low Ecological Integrity Part A	Low Ecological Integrity Part A	Low Ecological Integrity Part A
High Ecological Integrity Part B	Low Ecological Integrity Part B	High Ecological Integrity Part B	Low Ecological Integrity Part B	Low Ecological Integrity Part B
High Water Quality Maintenance	High Water Quality Maintenance	Low Water Quality Maintenance	Low Water Quality Maintenance	Low Water Quality Maintenance
High Aesthetic Potential	Low Aesthetic Potential	High Aesthetic Potential	Low Aesthetic Potential	Low Aesthetic Potential
High Wildlife Habitat			Low Wildlife Habitat	High Wildlife Habitat

The following five options provide some suggestions for possible management plans for the EUs which met the criteria under that Option.

Evaluation Units 6.1, 9.1, 12.1 and 13.1 fall under the criteria for Option A.
OPTION A: A plan should be developed to ensure future protection of this EU. The Town should investigate the possibility of purchasing or obtaining conservation easements on land in the Zone of Influence. A review of the current zoning and other land-use regulations covering the Zone of Influence should be done and any changes that ensure the continued protection be made. Consideration of a tidal marsh buffer zone will help to maintain high Ecological Integrity and Aesthetic Quality for the EU. The Conservation Commission should carefully review any plan that might affect the flow of fresh or salt water into and out of the EU. This includes road construction or improvement and development in the watershed of the EU.

Evaluation Units 2.1, 5.1 and 7.1 fall under the criteria for Option B.
OPTION B: Continued protection of the tidal flow to the EU is critical to maintaining it's integrity. A review of those functions that consider the Zone of Influence, Ecological Integrity Part B, Wildlife Habitat, and Aesthetic Quality, and question 6 of the Description of the Restoration Potential should help to identify those upland influences that are affecting the EU. A careful survey of the current use and land-use regulations in the Zone of Influence may reveal a problem which is negatively impacting the EU. If a current activity in the area is leading to the degradation of the EU and the Zone of Influence, a plan to mitigate the effects should be developed. Any changes in land-use regulations that can prevent further use of the Zone of Influence in ways that lead to damage of the EU should be explored.

No Evaluation Units fall under the criteria for Option C.
OPTION C: If an EU were to fall into this criteria, a further assessment of the possibility of restoring tidal flow should be done including the economic and engineering feasibility of improving or removing the structure restricting the flow. More specific information about the causes of the low Ecological Integrity of the EU should be collected, this may require expertise in wetland science and hydrology. A review of the current land-use regulations covering the Zone of Influence should be done and changes made that ensure the continued protection of this area.

Evaluation unit 4.1 fall under the criteria for Option D. (System 4 is formerly tidal.)
OPTION D: The management plan for the EU should carefully analyze what steps can be taken that will most directly influence the marsh. If changes in the current use of the Zone of Influence are unrealistic, it may be most effective to try to improve the flow of tidal waters to the EU. This action may have the greatest impact on the most functions. The control or elimination of invasive species present in the marsh will improve the Wildlife Habitat, Aesthetic Quality and Ecological Integrity of the EU. Activities in the Zone of Influence that can be easily changed to lessen the impact on the EU should be considered.

No evaluation units fall under the criteria for Option E.
OPTION E: If an EU were to fall in this category, consideration would need to be taken in regard to the effect that planned changes would have on the wildlife potential. Implementation of changes that improve Ecological Integrity of the EU while maintaining or improving the Wildlife Habitat are best to consider. However, changes that may negatively impact the current use of the EU by wildlife must be balanced against the improvement in other functions.

Out of 17 Evaluation Units, eight fell into a Management Options category as described by the Coastal Method Manual. In the next section of the report, management recommendations are presented for each System which includes the evaluation of recreation and education sites, and noteworthiness.

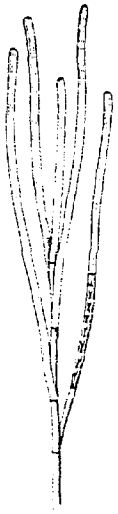
MANAGEMENT RECOMMENDATIONS FOR MARSH SYSTEMS/EVALUATION UNITS

Each Marsh System is presented with management recommendations in the following format: (1) Noteworthiness - this is the most important function to be considered in the protection of salt marshes and is therefore addressed first; (2) Recreation and Education Potential - this is an important resource and has long term value to the Town; (3) Hazards - are identified which are affecting the marsh and need to be considered in the protection and restoration of the marsh; and finally (4) Protection and Restoration of the EU - these are recommendations about the future monitoring and care of the EU which take into consideration the other factors provided in (1) through (3).

Marsh System 1 (Evaluation Units 1 and 2)

Noteworthiness: An AFI of .28 in EU 1 and of .46 in EU 2 make both EU's Noteworthy. In, *Tidal Rivers Land Protection Study of the Oyster, Lamprey and Salmon Falls River*, the authors describe Johnson's Creek as an unspoiled, priority wildlife habitat where the Creek winds inland through a succession of low marsh, high marsh, tidal and fresh water wetlands to a salthole at Gerrish Brook. It is stated that this area is the State's best example of a fresh water tidal marsh, and contains a rare plant community, Eelgrass, which is found along the Creek and is an important habitat for fish and wildlife.

Eelgrass



Source: Tiner, Ralph W. Jr. A Field Guide to Coastal Wetland Plants of the Northeastern United States. 1987.

Recreation/Education Potential:
This System did not score high in Recreation or Education Potential due to the lack of existing facilities and safety. The evaluators noted the availability of parking at the "industrial park" which is a Town owned lot cleared and adjacent to the water. The lot is zoned office/research and the Town has hopes of developing an industrial park there in the future, however, it would be an appropriate site for a visitors center and parking facility with linkages from one Marsh System to another. However, odor from the waste treatment plant was noted as a problem. See Map 3 for site specific details.

Hazards:
Phragmites near Route 4; potential impacts from the industrial park and residential development.

Protection/Restoration:

- If development persist along Johnson's Creek, the impact to this rare succession of habitats could be detrimental. Addressing this problem through less intense zoning and a shoreland protection policy will improve and protect this System.

- This Evaluation Unit should have the highest level of protection because of its Noteworthiness. It is recommended that the System be reevaluated once a year.

- Plans should be made for the control of invasive species.

Marsh System 2 (Evaluation Units 1 and 2)

Noteworthiness:
Both EUs making up Marsh System 2 have an AFI of .28, which is significant. According to the, *Tidal Rivers Land Protection Study of the Oyster, Lamprey and Salmon Falls Rivers*, "Bunker Creek is a meandering tidal creek bordered by salt marsh, a 100 acre tree farm, prime farmland, and the historic Bunker family graveyard. The Town of Durham still holds its ancient thatch bed, a rich high marsh near the mouth of Bunker Creek. Rare species have been mapped on nearly half the area of the tidal creek, occupying more of the site than the sensitive areas located on Johnson Creek. The scenic view upstream from Route 4 is enhanced by the rustic barn and pasture. This area is extensively used by herons and shorebirds."

Recreation/Education Potential:
This System did not score high in Recreation and Education Potential. As with System 1, this is mainly do to the lack of existing facilities such as parking, trails, etc., and unsafe access off of Route 4. See Map 4 for site specific details.

Hazards:
Residential development encroaching on this System. Some invasive species noted near the freshwater source (cattails). EU 1 does not have a woodland or idle land buffer which is important to filter/absorb some of the contaminates from the residential development.

Protection/Restoration:

- Evaluation Unit 2.1 falls under the criteria for **Option B:** *Continued protection of the tidal flow to the EU is critical to maintaining it's integrity. A review of those functions that consider the Zone of Influence, Ecological Integrity Part B, Wildlife Habitat, and Aesthetic Quality, and question 6 of the Description of the Restoration Potential should help to identify those upland influences that are affecting the EU. A careful survey of the current use and land-use regulations in the Zone of Influence may reveal a problem which is negatively impacting the EU. If a current activity in the area is leading to the degradation of the EU and the Zone of Influence, a plan to mitigate the effects should be developed. Any changes in land-use regulations that can prevent further use of the Zone of Influence in ways that lead to damage of the EU should be explored.*

- This System should have the highest level of protection due to its Noteworthiness. It is recommended that the System be reevaluated every year.

- A shoreland protection policy and zoning changes should be made to keep development set back from the shore. This Marsh System could be greatly improved by minimizing impacts within the 500 foot Zone of Influence.

- Trash clean up will improve the Aesthetic Quality of the area.

Marsh System 3

Noteworthiness:
This System did not rate high in the Noteworthiness function.

Recreation/Education Potential:
This System did not rate high in Recreation and Education Potential, again due to lack of facilities and poor access. See Map 5 for site specific details.

Hazards:
Some pragmites were identified.

Protection/Restoration:
- The System should be monitored or reevalutated at least every other year.
- Coordination for the care of this System should be arranged with the Madbury Conservation Commission.
- Plans should be made for the control of invasive species.

Marsh System 4 (Evaluation Units 1 and 2)

Tide gates (or flash boards) are located below the Route 108 bridge (placed there by NH DOT) which keep the tidal flow and fresh water from mixing. According to Chris Nash from the Coastal Program at the Office of State Planning, the impoundment serves to clean the bacteria and nutrients from the fresh water stream which flows down from the residential development. This impoundment, he believes, works better at removing the non-point pollution than a natural salt marsh because constant flooding of the area by tidal waters does not allow adequate time for the settlement of the pollutants.

In the document, *Oyster River Non-Point Source Pollution*, by Dr. Richard Langan and Dr. Stephen Jones, it was noted that the impoundment of water in ponds and marshes appeared to have a "positive impact on water quality, resulting in lower bacterial and nutrient concentrations being discharged downstream." These areas in Durham are Mill Pond, above the tidal dam (upstream from System 5); the pond behind the tide gate on Beards Creek (System 4); and the tidal marsh and freshwater marsh upstream from the mouth of Johnson Creek (System 1).

However, there are conflicting reports on the value of the impoundment. According to the "*Evaluation of Restorable Salt Marshes in New Hampshire*" the one inadequate restriction to tidal flow in Durham is between Systems 4 and 5 at Route 108. The recommendation by Alan Ammann, the author, is to remove the flashboards and restore over 25 acres of salt marsh in the Town of Durham.

Both points of view, for and against the removal of the flash boards, have valid issues which need to be considered. However, these issues can only be addressed at the local level and may involve hiring a consultant to perform feasibility and cost/benefit analyses.

Please keep in mind that this is now a fresh water system and therefore the scoring as a tidal marsh does not apply.

Noteworthiness:
This System did not rate high in the Noteworthiness function.

Recreation/Education Potential:
System 4 did not rate high in Recreation or Education Potential.

Hazards:
This System is a completely degraded salt marsh; it is considered "formerly tidal" with only fresh water plants evident.

Protection/Restoration:

- System 4 falls under the criteria for **Option D**: *The management plan for this EU should carefully analyze what steps can be taken that will most directly influence the marsh. If changes in the current use of the Zone of Influence are unrealistic, it may be most effective to try to improve the flow of tidal waters to the EU. This action may have the greatest impact on the most functions. The control or elimination of invasive species present in the marsh will improve the Wildlife Habitat, Aesthetic Quality and Ecological Integrity of the EU. Activities in the Zone of Influence that can be easily changed to lessen the impact on the EU should be considered.*

  Controlling the growth within the Zone of Influence and removing the tide gates would improve all of the functions of the wetland. If consideration is given to restoring System 4 to salt marsh, a consultant should review all of the issues and present them to the Town with a recommendation. If the Town decides instead to let it remain as a fresh water impoundment, than the area should be evaluated using the New Hampshire Method for fresh water wetland functions.

Marsh System 5

Noteworthiness:
This System did not rate high in the Noteworthiness function.

Recreation/Education Potential:
System 5 rated the highest of all Systems for Recreation (.79) and Education (.79) Potential. This is primarily due to existing recreation at Jackson Landing and the Shipyard Park. According to the *Tidal Rivers Land Protection Study of the Oyster, Lamprey and Salmon Falls Rivers*, "Jackson Landing is one of the best boat ramp areas in the estuary and coupled with the shipyard park provide key access to the Oyster River." It also notes that on the eastern border is the Shankhassick Trust which has exceptional scenic views. This System has potential for expanded recreation because of existing recreation and its central location. See Map 3 for site specific details.

Hazards:
Phragmites identified. Encroaching development has affected the Marsh, especially with regards to aesthetic quality.

Protection/Restoration:

- System 5 falls under the criteria for **Option B**: *Continued protection of the tidal flow to the EU is critical to maintaining it's integrity. A review of those functions that consider the Zone of Influence, Ecological Integrity Part B, Wildlife Habitat, and Aesthetic Quality, and question 6 of the Description of the Restoration Potential should help to identify those upland influences that are affecting the EU. A careful survey of the current use and land-use regulations in the Zone of Influence may reveal a problem which is negatively impacting the EU. If a current activity in the area is leading to the degradation of the EU and the Zone of Influence, a plan to mitigate the effects should be developed. Any changes in land-use regulations that can prevent further use of the Zone of Influence in ways that lead to damage of the EU should be explored.*

  Policies should be made which will limit the impact within the 500 foot Zone of Influence of the Marsh System.

- Although this System did not rate high in Noteworthiness, its high Recreation and Education Potential make it considerably valuable to the Town. This System should be monitored or evaluated at least every other year.

- Plans should be made for the control of invasive species.

Marsh System 6

Noteworthiness:
This System did not rate high in the Noteworthiness function. However, it did rate higher in more functions (5) that any other system.

Recreation/Education Potential:
This site rates as one of the highest for Education Potential (.79). This is because of existing parking and other facilities available to students as well as its proximity to a variety of habitats. Because of its existing parking, recreation and aesthetic quality it would be a preferred location for expanded recreation (System 6 scored low in Recreation Potential because there is no hunting.) See Map 4 for site specific details.

Hazards:
Invasive plant species were identified, Goldenrod and Purple Loosestrife.

Protection/Restoration:

- System 6 falls under the criteria for **Option A**: *A plan should be developed to ensure future protection of this EU. The Town should investigate the possibility of purchasing or obtaining conservation easements on land in the Zone of Influence. A review of the current zoning and other land-use regulations covering the Zone of Influence should be done and any changes that ensure the continued protection be made. Consideration of a tidal marsh buffer zone will help to maintain high Ecological Integrity and Aesthetic Quality for the EU. The Conservation Commission should carefully review any plan that might affect the flow of fresh or salt water into and out of the EU. This includes road construction or improvement and development in the watershed of the EU.*

  This means that the Town should consider protecting this System to the fullest extent because of the functional values it serves to the Town. Land parcels should be reviewed for possible protective conservation methods such as easements, or deed restrictions.

- Because of the value of this System to the Town, and the plan to develop the area for more intense recreation, this System should be monitored or reevaluated at least once a year.

- Plans should be made for the control of invasive species.

Marsh System 7

Noteworthiness:
System 7 did not score high in the Noteworthiness function.

Recreation/Education Potential:
System 7 did not score high in Recreation or Education Potential. A small boat launch area exists but since this is such a small System expanded recreation or an education site are not recommended. See Map 5 for site specific details.

Hazards:
Invasive species were identified. The area surrounding this System is fairly intense residential development. The System scored low in general appearance and high in noise level which attributed to a low score in Aesthetic Quality. Within the Zone of Influence of this System the development is too intense to not adversely affect such a small System (3 acres).

Protection/Restoration:

- System 7 falls under the criteria for **Option B**: *Continued protection of the tidal flow to the EU is critical to maintaining it's integrity. A review of those functions that consider the Zone of Influence, Ecological Integrity Part B, Wildlife Habitat, and Aesthetic Quality, and question 6 of the Description of the Restoration Potential should help to identify those upland influences that are affecting the EU. A careful survey of the current use and land-use regulations in the Zone of Influence may reveal a problem which is negatively impacting the EU. If a current activity in the area is leading to the degradation of the EU and the Zone of Influence, a plan to mitigate the effects should be developed. Any changes in land-use regulations that can prevent further use of the Zone of Influence in ways that lead to damage of the EU should be explored.*

  Better land management practices within the Zone of Influence will improve the functions of the System.

- Monitoring or reevaluating the System at least every other year is recommended.

- Trash pick-up should be arranged.

- Plans should be made for the control of invasive species.

Marsh System 8

Noteworthiness:
This is a Noteworthy System, with an AFI of .28, because it is a habitat for federally threatened or endangered species.

Recreation/Education Potential:
The System did not rate high in Recreation or Education Potential and the evaluators made no recommendations for recreation or education sites in the area. See Map 4 for site specific details.

Hazards:
None were identified.

Protection/Restoration:

- Due to the System's Noteworthiness, it should receive the highest level of protection and be reevaluated once a year.

- There is development in this area but it does not seem to have greatly affected this Marsh System. However, this area has the potential to become more densely developed in the near future and therefore the Town should maintain a strong shoreland/wetlands protection ordinance to protect the marsh.

Marsh System 9

Noteworthiness:
This System did not rate high in Noteworthiness. However, it is important to note that the, *Tidal Rivers Land Protection Study of the Oyster, Lamprey and Salmon Falls Rivers*, mentioned the area as being meticulously maintained in its rural character and scenic beauty which is important to the quality of life in Durham.

Recreation/Education Potential:
System 9 did not rate high for either Recreation or Education Potential (no hunting allowed lowers the score for Recreation Potential). See Map 6 for site specific details.

Hazards:
Some invasive species were identified.

Protection/Restoration:

- This System falls under the criteria for **Option A**: *A plan should be developed to ensure future protection of this EU. The Town should investigate the possibility of purchasing or obtaining conservation easements on land in the Zone of Influence. A review of the current zoning and other land-use regulations covering the Zone of Influence should be done and any changes that ensure the continued protection be made. Consideration of a tidal marsh buffer zone will help to maintain high Ecological Integrity and Aesthetic Quality for the EU. The Conservation Commission should carefully review any plan that might affect the flow of fresh or salt water into and out of the EU. This includes road construction or improvement and development in the watershed of the EU.*

  The System scored high in the majority of the functions. Protecting these functions may be provided by land conservation measures such as easements, deed restrictions and policy changes in zoning and shoreland protection which should be pursued by the Town.

- It is recommended that this System be monitored or reevaluated at least every other year.

- Plans should be made for the control of invasive species.

Marsh System 10

Noteworthiness:
System 10 did not rate high in Noteworthiness.

Recreation/Education Potential:
This System rated high in Aesthetic Quality and the evaluators believed that it would make a good Education and Recreation site because of this. However, the lack of existing recreation trails and other infrastructure made the potential for recreation or education low. See Map 6 for site specific details.

Hazards:
Trash was identified as a small problem.

Protection/Restoration:
- Monitoring or reevaluation is recommended to take place at least every other year.
- Trash clean-up at this site should be arranged.

Marsh System 11

Noteworthiness:
This System did not rate high in Noteworthiness.

Recreation/Education Potential:
System 11 did not score high in Recreation or Education Potential. However, there are approved shellfish beds, canoe/boat access and passage which can be maintained or developed to be used in conjunction with Systems 12 and 13 (Adams Point). See Maps 7 and 8 for site specific details.

Hazards:
Development within the 500 foot Zone of Influence.

Protection/Restoration:

- Overall the scores for this System are relatively good. Protection of the area surrounding the System, by land use regulations, etc., will ensure its value as a Marsh System to the Town. This is especially important since System 11 abuts Systems 12 and 13, which are valuable Town resources for recreation, education, wildlife habitat and aesthetics.

- It is recommended that monitoring or reevaluation take place at least every other year.

Marsh System 12

Noteworthiness:
System 12 rates high in Noteworthiness for being (1) a habitat for threatened and endangered species, (2) for being a US Fish and Wildlife Service Management Area, (3) for being part of the Oyster River Plantation and (4) for being a site for long term research at Jackson Laboratory.

Recreation/Education Potential:
System 12 rates high in Recreation and Education Potential (.75 and .62 respectively). The Town of Durham and Jackson Laboratory should consider developing the area more extensively for education and recreation. See Map 8 for site specific details.

Hazards:
Some invasive plant species were identified.

Protection/Restoration:

- System 12 falls under the criteria for **Option A**: *A plan should be developed to ensure future protection of this EU. The Town should investigate the possibility of purchasing or obtaining conservation easements on land in the Zone of Influence. A review of the current zoning and other land-use regulations covering the Zone of Influence should be done and any changes that ensure the continued protection be made. Consideration of a tidal marsh buffer zone will help to maintain high Ecological Integrity and Aesthetic Quality for the EU. The Conservation Commission should carefully review any plan that might affect the flow of fresh or salt water into and out of the EU. This includes road construction or improvement and development in the watershed of the EU.*

  Conservation easements and other land use protection measures should be considered to protect this System.

- Due to its Noteworthiness, this System should be monitored or reevaluated at least once a year.

- Plans should be made for the control of invasive species.

Marsh System 13 (Evaluation Units 1 and 2)

Noteworthiness:
Both Evaluation Units scored high in Noteworthiness. The area is a site for long-term research at Jackson Laboratory. Evaluation Unit 13.1 is a site for threatened and endangered species.

Recreation/Education Potential:
This would made an excellent site for a small visitors center maintained by both the Town of Durham and Jackson Laboratory, which could serve as an education and recreation information center. See Map 8 for site specific details.

Hazards:
At Evaluation Unit 13.2 the evaluators identified invasive species and scored the culvert as slightly less than adequate for tidal flow (.3). However, in the *Evaluation of Restorable Salt Marshes in New Hampshire*, the restriction between the Evaluation Units was evaluated as adequate.

Protection/Restoration:

- System 13 (both Evaluation Units) fall under the criteria for **Option A**: *A plan should be developed to ensure future protection of this EU. The Town should investigate the possibility of purchasing or obtaining conservation easements on land in the Zone of Influence. A review of the current zoning and other land-use regulations covering the Zone of Influence should be done and any changes that ensure the continued protection be made. Consideration of a tidal marsh buffer zone will help to maintain high Ecological Integrity and Aesthetic Quality for the EU. The Conservation Commission should carefully review any plan that might affect the flow of fresh or salt water into and out of the EU. This includes road construction or improvement and development in the watershed of the EU.*

  Meaning purchasing land parcels, easements, deed restrictions, policy changes such as shoreland protection and zoning should be considered to protect the integrity of the area.

- Because of the System's Noteworthiness value, reevaluation should take place at least once a year.

- At Evaluation Unit 13.2 a plan should be made for the control of invasive species.

- Evaluators also recommended a reduction of the fill on this EU.

ANNOTATED BIBLIOGRAPHY

Armstrong, J. et al. 1974. Coastal Zone Management: The Process of Program Development. Coastal Zone Management Institute. Sandwich, Massachusetts.

In 1972 The Coastal Zone Management Act was enacted. This legislation called for several coastal states, including New Hampshire, to develop coastal resources management programs which will provide for wise and effective management of the nation's valuable coastal areas. The document provides an in depth discussion on various elements of the Act as well as an analysis of the key factors involved in forming a management program. Even though the focus of discussion is based on the formation of a state program, there are various issues that are equally important to the Town of Durham in addressing the protection of their tidal wetlands. Factors to consider include: determining land and water uses to be assessed for impact on coastal environments, inventory of existing land and water uses, and analysis of existing comprehensive plans for coastal zones. A partial listing of associated problems to be considered when protecting coastal systems includes the following:

ESTUARY WATERSHED: groundwater or stream pollution, estuary water quality and effects on biota, groundwater or stream water flows, estuary and wetland salinity and effects on biota, stream sediment loads, estuary sedimentation, deposition of beach materials on estuary, direct discharge of wastewater into estuary from all sources.

POPULATIONS OF SPORT AND COMMERCIAL SPECIES: degradation of coastal streams and size of anadromous fish populations, degradation of estuarine habitats and size of waterfowl, wildlife, and fish populations, harvesting of commercial or sport species and maintenance of a sustained yield population and food web

PUBLIC SERVICES: land use within sewage/water services district and the capacity of those systems, land use within highway service area and highway congestion

PRIORITY USES:

- areas that are unique, fragile or vulnerable
  - High - scientific, educational, recreational
  - Low - intensive public recreation, residential
- areas of high natural productivity or essential habitat
  - High - fish and wildlife refuge, fishing
  - Low - refineries, warehouses, power plants, residences on fill
- areas of substantial recreational value
  - High - public beach, resort development
  - Low - pulp mills, steel plants, sand and gravel extraction
- areas of urban concentration where uses are highly competitive
  - High - those uses which reduce conflicts
  - Low - those uses which maintain or increase conflicts
- areas of significant hazard if developed
  - High - park, agriculture
  - Low - residential developments, schools, hospitals
- areas needed to protect, maintain or replenish coastal lands/resources
  - High - agriculture, recreation, scientific and educational reserves, refuges
  - Low - solid waste disposal

Breeding, C.H.J., F.D. Richardson and S.A.L. Pilgrim. 1974. Soil Survey of New Hampshire Tidal Marshes. Research Rep. no. 40. New Hampshire Agricultural Experiment Station. University of New Hampshire, Durham. 94pp.

Historically tidal marshes provided valuable hay and pasturage to farms, even today fine salt meadow grass (S.

patens) is cut, cured and sold as salt hay for livestock feed. There are three important qualities of NH's tidal soils that address the limitations of their use.

(1) daily flooding
(2) inability to support heavy loads such as roads and structures
(3) release of sulfur (acid form) after prolonged exposure to air has the potential to corrode metal and concrete materials

Because of these issues these soils are best suited for limited recreational use and as a natural habitat. There is a very specific vegetal cover that grows in tidal marsh soils. Spartina alterniflora is the first species to colonize the intertidal zone. Soil moisture, nutrient availability and salinity are all influences. As the surface of the marsh rises the S. alterniflora is replaced by Spartina patens, this replacement is often gradual with the two species growing together. Neither will grow in areas of continuous soil saturation or standing water. The tidal soils found in the publication's study area along the Oyster River and Little Bay include: Typic Sulfihemist (397), Terrific Sulfihemist (597) and Sulfihemist (997).

397 - This soil is characterized as organic material thicker than 50 inches. The periodic flooding, slow internal drainage and sulfide content are the principal problems to management; these three issues combined with low bearing strength present severe limitations to its use for community development. The soil is well suited to wetland habitat development.

597 - This soil is characterized as organic materials 16 to 50 inches thick overlying silty materials. This soil has properties that make it unfavorable for community and recreational development uses, it is not suitable for farming. It is well adapted for use as wetland wildlife habitat development. Dominant natural vegetation is S. patens on the high marsh and S. alterniflora on the intertidal marsh.

997 - This soil is characterized as a surface soil with low salt, organic materials thicker than 50 inches or 16 to 50 inches thick overlying sandy or silty materials. The slow internal drainage, a very high water table, presence of sulfitic materials and periodic flooding are major problems with this soil type. Further restrictions are its long narrow shape and small size. The soil has little or no value for farming and will not support forest tree growth. It is well suited to wildlife habitat development. Dominant natural vegetation includes S. alterniflora (intertidal) and S. patens (high marsh).

Comprehensive Planning, New Hampshire Office of. 1975. New Hampshire Coastal Resources: A Summary.

This packet contains information gathered from the Coastal Zone Study initiated by the original Coastal Resources Management Program in 1974. There are four maps on which this information is represented. The first map defines the Coastal Zone Boundaries. According to this map the study area for the Durham Coastal Wetlands project is considered to be a Primary Zone, which is approximately 17% of Durham's area. The Primary Zone is defined as all tidally influenced waters from either the mean high watermark or landward edge of a salt marsh to either the first 20FT elevation contour or a distance of 1000FT which ever is furthest. The remaining 83% of Durham is in the Secondary Zone. The second map describes the Land/Water Use and Vegetative Cover. More than half of the land adjacent to the Oyster River,at the time the map was created, is predominantly agriculture and abandoned land, only a few sections of residential development exist. The third map highlights Areas of Particular Concern. Land adjacent to the Oyster River was designated for floodplain concerns. The land adjacent to Little Bay was also a concern because of its steep slopes as well as the location of various shellfish beds. The fourth map is a Land and Water Capability map which identifies, in summary, the natural ability of land and waters to sustain development. In general the land capability for the study area is rated as fair to poor due to the existence of floodplain, wetlands, seasonably wet soils and steep slopes. There are a few areas that are rated a little different: (1) a small parcel at Durham Point is rated as good, (2) a section of land on both sides if Horsehide Brook is rated as excellent and (3) the area along Rte. 108 by Jacksons Landing is coded as existing urban. In terms of water capability, the water in Little Bay and the mouth of the Oyster River are rated as fair, meaning water depth, bridges, and currents restrict boat activity to recreation and small commercial activity and overall development potential is fair. Moving further inland, the head waters of the Oyster River and the water beyond Adams Point were rated as poor, meaning this

area is quite sensitive to intrusions by man. Existing water uses are of low intensity and overall development potential is classified as poor.

Cook, R.A., A.J. Lindley Stone and A.P. Ammann, 1993. Method for the Evaluation and Inventory of Vegetated Tidal Marshes in New Hampshire. Published by the Audubon Society of New Hampshire.

Cowardin, L. et al. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service.

Defines a classification of wetlands in a hierarchical form consisting of system, subsystems, classes and subclasses. For our purposes the classification we follow is:

- Estuarine
  - Subtidal
    - Rock Bottom
    - Unconsolidated Bottom
    - Aquatic Bed
    - Reef
  - Intertidal
    - Aquatic Bed
    - Reef
    - Stream Bed
    - Rocky Shore
    - Unconsolidated Shore
    - Emergent Wetland
    - Scrub-shrub Wetland
    - Forested Wetland

Environmental Services, New Hampshire Department of. 1994. Lamprey River Management Plan - DRAFT.

This management plan creates a framework for successful long-term use and protection of the Lamprey River. Recognizing that the river is an important community resource, the plan addresses five aspects of the river's ecology and outlines a strategy of management and protection elements that each community along the river shore should enforced.

Jones, S.H. and R. Langan. 1994. Land Use Impacts on Nonpoint Source Pollution in Coastal New Hampshire Watersheds. Final Report to the New Hampshire Coastal Program, Report no. 200. NH Office of State Planning. Concord, New Hampshire.

The Oyster River Watershed was selected as a model to develop an effective system of assessing potential nonpoint source pollution problems. The study concentrated on the tidal area of the main river and in two small watersheds, Johnson Creek and Beards Creek. Jones and Langan claim that the results of baseline water quality data suggest that Beard's Creek and the freshwater portion of the Oyster River are both relatively contaminated compared to the well-mixed estuarine water at the mouth of the Oyster River. In addition to the point source nutrient loading from the sewage treatment plant in the tidal portion of the Oyster River, sample data indicated that there are other sources in the river as well. Johnson Creek appears to be the largest source of these dissolved nutrients and bacterial indicators. Upon completion of a land use impact assessment study in the Johnson Creek watershed, the primary

land use and possible contaminant sources identified were private sewage disposal systems associated with residential development. Water sampling revealed that contaminant levels were relatively low at the mouth of the Creek compared to upstream sites. The authors indicate that the extensive salt marsh at the mouth of the Creek may influence the contaminant levels. Sampling along the length of the marsh suggest that the mixing of freshwater with low salinity water could induce the sedimentation of these particle bound contaminants.

Jones, S.H. and R. Langan. June 1993. Oyster River Nonpoint Source Pollution Assessment. Final Report to the New Hampshire Coastal Program, Report no. 163, NH Office of State Planning. Concord, New Hampshire.

This study made an assessment of nonpoint source pollution in the Oyster River watershed. Emphasis was made on the tidal portion of the river and the tributaries that empty directly into the tidal river. Their findings are summarized as the following;

- bacterial and nutrient levels in the tidal area were as high or higher than recent measurements made in other tidal rivers in the Great Bay Estuary
- the bacterial contamination is dominated by nonpoint sources such as on site private sewage disposal systems, associated groundwater flow, urban and agricultural surface runoff, as well as other undetermined sources
- the Durham POTW, and potentially some sewer lines, may be intermittent sources of contamination
- the POTW was found to be a major point source of nutrients which masked nutrient inputs from other sources
- the impoundment of water in ponds and marshes appear to have a positive impact on water quality, resulting in lower bacterial/nutrient counts being discharged downstream
- critical areas that should be protected through more strict land use regulations include the shoreline of the tidal river, salt and freshwater marshes along the tidal river and in the tributaries, and water impoundment areas on the tributaries.

Rist-Frost Associates, P.C. May 1989. Town of Durham Master Plan Update Final Report.

The goal stated in the Land Use section of the Durham Master Plan calls to provide a well balanced land use pattern to meet present and future community needs in an efficient, environmentally sound, economical and equitable manner, and to preserve and protect open space for conservation and recreation purposes. Of the many objectives involved in forming this goal, the protection of environmentally sensitive areas such as water sheds, aquifers, coastal shorelines, floodplain and stream banks and the preservation of scenic areas, prime agricultural lands, wildlife areas and conservation/recreation corridors are most affected this study. To meet those objectives it was recommended that these as well as other actions be taken by the Town:

- identify, prioritize, and preserve properties which the Conservation Commission has determined to require protection
- establish new shoreline protection zones that distinguish between major and minor bodies of water
- continue participation in the New Hampshire Coastal Program administered through the Office of State Planning
- obtain conservation easements to complete the preservation of the Crommett Creek/Durham Point corridor for conservation and passive recreation purposes

Short, F.T. 1992. (ed.) The Ecology of the Great Bay Estuary, New Hampshire and Maine: An Estuarine Profile and Bibliography. NOAA - Coastal Ocean Program Publication 222pp.

Short has written this profile as a document to be read by people with varying backgrounds, scientists, management agency personnel, monitoring groups and concerned citizens alike. The material is a lengthy overview of the

ecology of the Great Bay Estuary. Topics that Short covers includes the history of human activities, characterization of habitats, hydrosystem, geomorphology, hydrochemistry, pollution, primary producers, consumers, and biogeochemical processes of Great Bay. One of the management issues discussed in the summary is the restoration or mitigation of lost wetlands. He points out that continued development within the watershed only leads to a continued loss of productivity and degradation of wetland areas. Short also emphasizes the responsibility of the Reserve to educate the public, governmental agencies, and private interest groups about the value of the estuary and the need to maintain a healthy productive estuarine environment.

Sperduto, D.D. October 1994. Coastal Plain Pondshores and Basin Marshes in New Hampshire. Report to the Environmental Protection Agency - Region I. Wetlands Protection Section. Boston, Massachusetts.

These coastal plain communities are regionally and globally rare and threatened. They are in fact among the rarest ecosystems in New Hampshire. The focus of this study was to determine the status, distribution, and vegetative variation of these wetlands. Sperduto determined that there are presently 20 known fair to excellent quality basin marshes and 14 sandy pondshore/river shore examples in New Hampshire. There were three sites found within the Town of Durham that are of local interest.

- **Durham Point Road**; east side of road between road to the Buffalo Farm and Langmaid Road. The site is and irregularly shaped small vernal pool/basin marsh (about .05AC) with sparse vegetation and some surface stones; it was probably a pasture pond long ago; it is probably impacted by road runoff; the site is only of local significance due to its small size, but is worthy of protection at this level
- **Dame Road Basins**; .1 miles north of Dame Road; first basin is .15 miles west of its east end, is about .5AC in size; second basin is .25 miles north-northwest of the first and is approximately .16AC in size; the pond may have been a pasture pond long ago; the site is significant at a local level given its size and rarity ranking
- **Little Hook Road**; located west of Little Hook Road just north of Wiswell Road there are two closed drainage basins; the most southern is a small (70FT diameter) depression; the second, just .1 miles north has a basin swamp at its southeast end and a large vernal pool (200' by 50') at its northwest end; given the proximity of the large population of Blanding's turtles just north of the headwaters, it is possible that these wetlands are used during part of their seasonal meanders; vernal pool and basin marsh functional values cam be depleted by development and its secondary impact through septic nutrient loading, water table alterations, physical degradation and fragmentation of amphibian/reptile corridors; these do not appear to be current issues but have potential without stronger protection in the future.

State Planning, New Hampshire Office of. June 1994. Comparison of Existing Coastal Community Shoreland Protection Ordinances to Comprehensive Shoreland Protection Act Minimum Standards.

The report investigates the status of shoreland protection in New Hampshire coastal communities. CSPA's minimum standards include a 250' limited use protected shoreland; a 150' natural woodland buffer, 75'-125' septic leachfield setback; and a 50' primary building line setback. Durham is recognized as having a shoreland, a wetland as well as an Aquifer Protection Ordinance. The town has one of the most extensive list of prohibited uses identified by CSPA in their shoreland ordinance. In addition to those, Durham also prohibits the disposal of liquid or leachable wastes, pesticide/herbicide use, tilling of soil and the establishment of feedlots. Durham requires a 150' setback for all septic systems (not just leachfields) which is stricter than CSPA minimum standards. Durham has a tidal and nontidal protection zone of 150' and the vegetated buffer prohibits the cutting of trees over 6" DBH. Durham's primary building line setback is 125' from the reference line of public waters. Although Durham does not meet all CSPA minimum standards, there are provisions established in their ordinances that are more stringent or that

are not even addressed by CSPA.

State Planning, New Hampshire Office of. 1983. Great Bay Facts and Figures.

OSP prepared this document as an educational tool in order to recognize the local, state and national importance of the Great Bay Estuarine System in a coordinated program of research, education and resource conservation. The report contains information about the land use around the Bay, estuarine access areas and population growth. The predominant land uses along Durham's bay shoreline are large-lot residential and agricultural, with most of the immediate shore being wooded.

Total Land Area	1453 acres	
Tidal Wetlands	69 acres	
State Land	81 acres	
Other Public Land	6 acres	
Other Conservation/ Recreation Land	0 acres	
Developed Land	193 acres	
Undeveloped Land*	1104 acres	*64% of this land is in Current Use

Durham has many estuarine access points. There are three public boat accesses: Cedar Point, Jacksons Landing and Adams Point. There is one water front park: Shipyard Landing, ~3 acres with picnic tables and historic information. Adams Point, ~82 acres in size, is the largest single parcel of public land devoted to conservation that is open to the public. The Scammel Bridge wayside area has limited parking area but provides views of both Little Bay and the Bellamy River.

In terms of population, Durham's has increased by 94% between 1960 and 1980. Between 1970 and 1980 the number of single family units grew by 27%, with a total number of units increased by 39%. It has been projected that Durham's population will grow another 27% between 1980 and 2000, it is expected that development will follow suit.

State Planning, New Hampshire Office of. 1989. New Hampshire Wetlands Priority Conservation Plan - An Addendum to the New Hampshire State Comprehensive Outdoor Recreation Plan (SCORP)

In order to address wetlands as an important outdoor recreation resource, this plan makes an in depth investigation of the status and the issues concerning both freshwater and saltwater wetlands in the State of New Hampshire. It has been estimated that more than half of the original 15,000 acres of tidal marshes have been destroyed either by fill or being cut off from their tidal source by roads or other construction. The plan identifies the salt marshes of the Great Bay, approximately 838 acres, to be a vital resource. The report also looks at various federal and state programs currently involved in protecting wetlands as well as specific plans and programs that have previously developed priorities for wetland protection.

State Planning, New Hampshire Office of. 1988. Wetlands Mitigation/Restoration Issues. Technical Bulletin Number 2

The Office of State Planning and the New Hampshire Wetlands Board have realized that developers are willing to invest into dredging and filling of wetlands to accommodate increased growth. The potential profit of developing these areas more than compensates the initial cost of land alteration. Developers have also proposed the use of mitigation as incentive for obtaining wetland permits. This paper identifies when mitigation should occur, the criteria for considering mitigation, types of replacement wetlands and federal mitigation policies.

Strafford County, New Hampshire Conservation District. March 1990. Tidal Rivers Land Protection Study of the Oyster, Lamprey, and Salmon Falls Rivers. 42pp.

This study locates and prioritizes parcels of land for acquisition and protection in order to increase conservation, public access, open space, and recreation opportunities along the tidal rivers. It begins with a review of property information and tax maps. Data on species and natural communities is compiled from information provided by the Natural Heritage Inventory, the New Hampshire Audubon Society and field observations. Water frontage figures are approximations derived from tax map information, aerial photos and landowner records. It is the opinion of the study that the coastal zone is no place for more intensive development. The study further identifies ten parcels of property along the Oyster River which should be a priority for protection; a method as well as a time frame for protection is also suggested; they include the following:

Wagon Hill Farm - at publication, a strategy was being determined

Smith Creek - preservation of open space across from Wagon Hill would help keep Smith Creek in its present healthy condition. An easement on the land buffering the creek is recommended

Bunker Creek - noted for the habitat it provides for endangered and threatened bird species, it is recommended that an easement on the low marsh areas be obtained

Johnson Creek - a pristine tidal creek, expansive marsh, diverse wildlife habitat and the presence of eelgrass (critical to some fish and wildlife), all suggest that an easement is recommended to maintain this outstanding open space area.

Jackson Landing Area - this area has a diverse wildlife habitat as well as rare plant species. 5AC of land owned by the Jacques family adjacent to the Jackson Landing property owned by the Town would be an important addition to the Town's open space and could be used for environmental education; this could be acquired through fee simple acquisition

Shankhassick Trust - high conservation values and also offers scenic views to people using the town land across the river, an easement along this property is recommended

Horsehide Brook - because this area offers such a strong wildlife habitat, a wide buffer conservation easement is recommended to protect this resource

Drew's Creek - it is important for the town to encourage the preservation of the land in the Richmond and McNitt tree farm; the open space is valuable and the tidal marsh ecosystem is fragile and must be protected; first, tax abatements should be installed to encourage open space use, second, a land easement along the creek should be considered

Durham Point - this area is outstanding in terms of maintaining open space and preserving the rural character and scenic beauty; considering how important these properties are to the quality of life in Durham as well as to the quality of the estuarine system; protection by easement along the coast is highly recommended

Tiner, Ralph W. 1987. A Field Guide to Coastal Wetland Plants of the Northeastern United States. The University of Massachusetts Press. Amherst.

The method used for this project evaluates wetlands on the basis of vegetation. Tiner's book contains over 100 pages of nontechnical wetland plant descriptions and illustrations arranged according to their wetland habitat. This book is extremely valuable for nonprofessional volunteers and conservation commissioners interested in coastal habitats. Plants observed in the field that were identified with the book include:

Narrow-leaved Cattail	(*Typha angustifolia*)
Common Reed	(*Phragmities australis*)
Saltwater Cordgrass	(*Spartina alterniflora*)
Salt Meadow Grass	(*Spartina patens*)
Purple Loosestrife	(*Lythrum salicaria*)

Tiner also includes a section of maps and descriptions of places with good public access to observe coastal wetlands

in the northeast. The only place listed for the state of New Hampshire is Adams Point where the University of New Hampshire's Jackson Estuarine Laboratory is located.

United States Department of Agriculture, Soil Conservation Service. 1994. Evaluation of Restorable Salt Marshes in New Hampshire. USDA Soil Conservation Service. Durham, New Hampshire.

The purpose of this study was to inventory and evaluate non-natural restrictions to tidal flow in the salt marshes of New Hampshire. It also determined the restoration potential of those marshes that have deteriorated due to the presence of a restriction. The study found numerous locations where salt marshes have degenerated because of a lack of tidal flow. For the Town of Durham there are three different tidal inlets present along the Oyster River; Bunker Creek, Johnson Creek and Beards Creek. The study determined that the inlets on Johnson Creek and Bunker Creek are considered adequate, Beards Creek however, was inadequate due to a restriction under state jurisdiction. It was determined that the inlet restriction effects 25.2 acres of salt marsh. The corrective action suggested is to remove the flashboards.

United States Department of the Army, Corps of Engineers. 1969. Survey of Great Bay and Little Bays and their Tributaries and Adjoining Tributaries of the Piscataqua River, New Hampshire and Maine. Department of the Army, New England Division, Corps of Engineers. Waltham, Massachusetts.

The purpose of this survey is to determine the need of providing navigational improvements to the bay area. A public hearing held in Durham, determined the following improvements that are desired by local interests: installation of additional boat ramps, additional channel and obstruction markers, dredge and anchorage basin adjacent to each of the town landings along the Oyster River, dredge a short access channel to the proposed estuarine laboratory on Adams Point, dredge a channel to the State boat ramp near Adams Point. It was noted that some of these requests were outside the purview of the Corps of Engineers, others were the responsibility of other public agencies. Local authorities expressed their view that the municipalities, at this time, are financially unable to contribute to these improvements.

The Division Engineer found that the waterways are adequate for present navigational needs. The waterway is in a fast growing part of New England with increasing demands for water access and recreational boating. He also noted that the land ownership in the bay area is in large holdings, and it appears that municipalities would benefit by establishing zoning control to guide the future shoreland development. (Maps of areas discussed are included)

United States Department of Commerce, Office of Ocean and Coastal Resource Management. 1978a. New Hampshire Coastal Program and Draft Environmental Impact Statement Appendices. U.S. Department of Commerce, NOAA. Washington, D.C. 153pp.

The appendices for the Coastal Program EIS contain excerpts of various NHRSAs relevant to the protection of New Hampshire's coastal waters. Those important to this report include:

RSA 483-A Fill and Dredge in Wetlands
Chapter 600 Coastal Wetlands Regulations
Chapter 400 Shoreline Structures
Rules and Regulations Pertaining to Harbors and Tidal Waters of the State of New Hampshire

Zoning. Chapter 172. From the Code of the Town of Durham. 1993. General Code Publishers Corp.

In brief, the Zoning Ordinances for the Town of Durham contain two articles which address the purpose of preserving the air and water quality; to protect natural and scenic resources from degradation and to ensure that development is commensurate with the character and physical limitations of the land.

- **Article V** defines the Wetland Conservation Overlay District. According to the ordinance the regulations of this district are intended to control and regulate the development of structures and of land use on naturally occurring wetlands, to prevent unnecessary/excessive expense to the town to provide services/utilities as result of inharmonious use of wetlands, prevent the destruction of natural wetlands, protect existing natural wetland wildlife habitats, encourage those uses that can appropriately and safely be located in wetland areas, and to prevent damage to abutter's structures and properties.
- **Article X** defines the Shoreland Protection Zone, the intent of this zone as written is to protect the water quality of current and future public drinking water supplies from pollutants, to protect water bodies from sedimentation/erosion, to maintain shorelands as habitats and travelways for wildlife, prevent destruction of aesthetic qualities of the shores (protecting property and recreational values), to protect the Great Bay estuary from pollution by its tributaries or from uses of its shoreland.

The overall strength and level of enforcement used through the adoption of these articles has not been determined.

Durham Zoning with Wetland Systems

Map 1

N

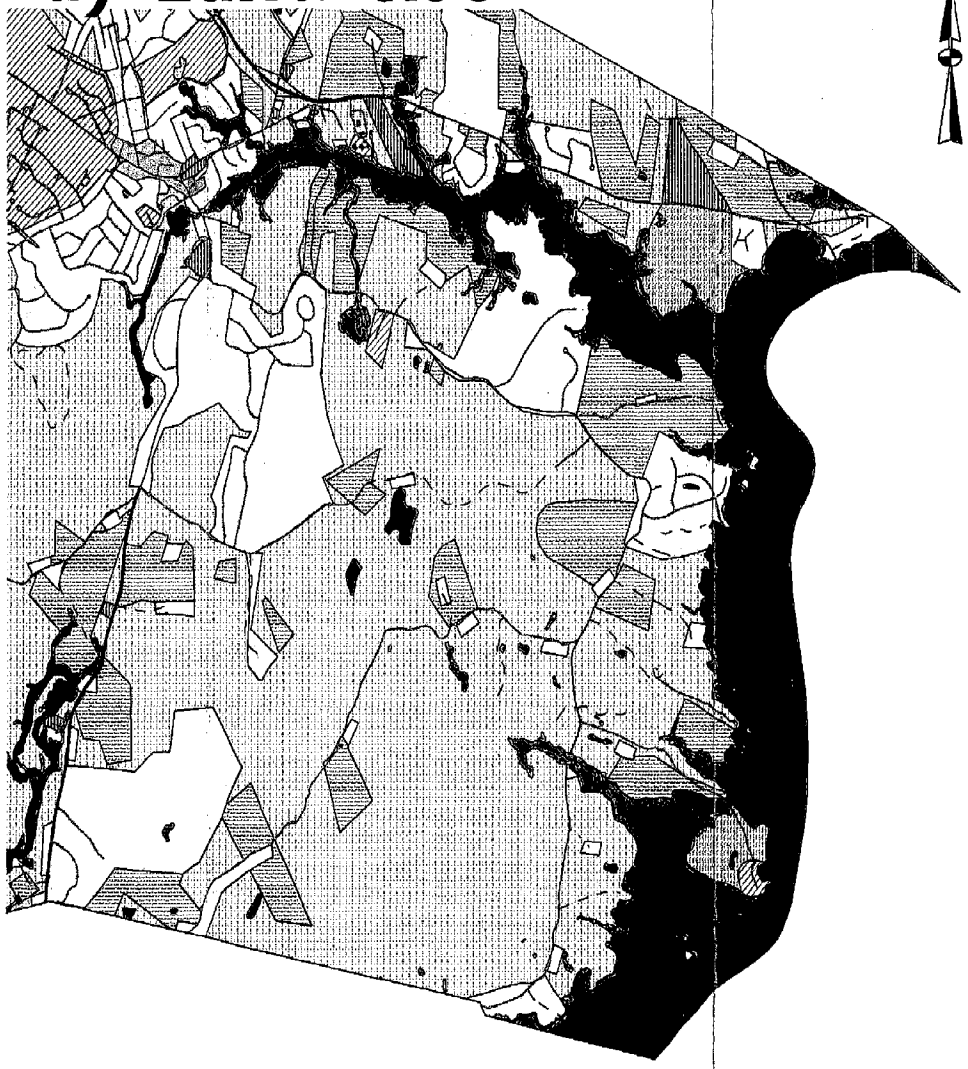
Great Bay Wetlands Coverage
- Salt Marsh
- Algae
- Upland
- Water

Land Use
- Water

Zoning
- CB - Central Business
- LB - Limited Business
- OR - Office and Research
- R - Rural
- RA - Residential A
- RB - Residential B
- RC - Residential Coastal

Durham, Great Bay Land Use

Map 2

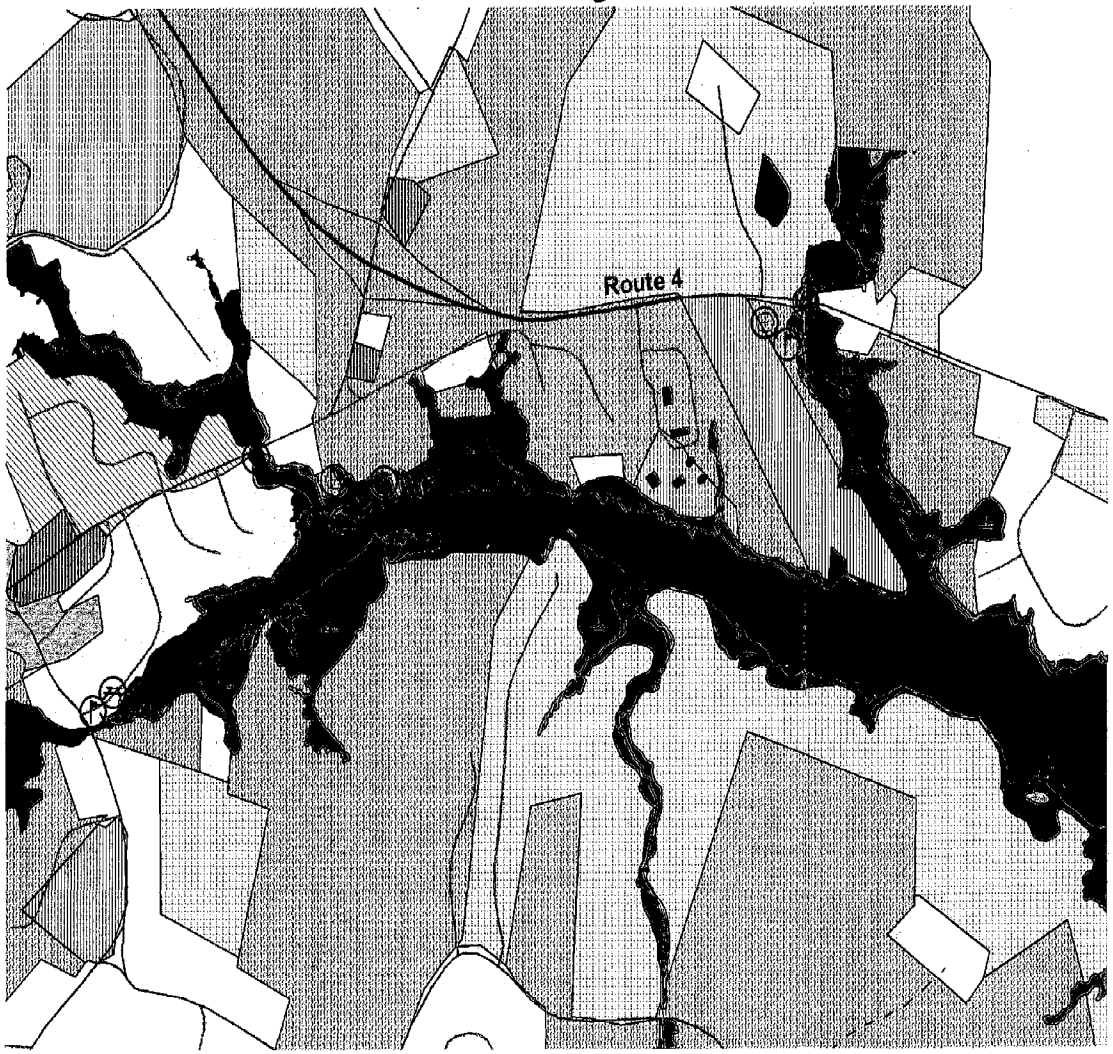


Great Bay Wetlands Coverage
- Salt Marsh
- Algae
- Upland
- Water

Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

Coastal Method Systems 1, 4 and 5



N

Map 3

Great Bay Wetland Coverage
- 1 Salt Marsh
- 2 Algae
- 3 Upland
- 4 Water
- 5 Unknown

Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

- Restriction, obstructing flow
- Restriction, not obstructing flow
- Primary Viewing Location
- Picnic Area/Grills
- Recreation Site/Trails
- Potential Recreational Site/Trails
- Public Boat Access
- Potential Educational Site

Coastal Method Systems 2, 6 and 8

Map 4

N

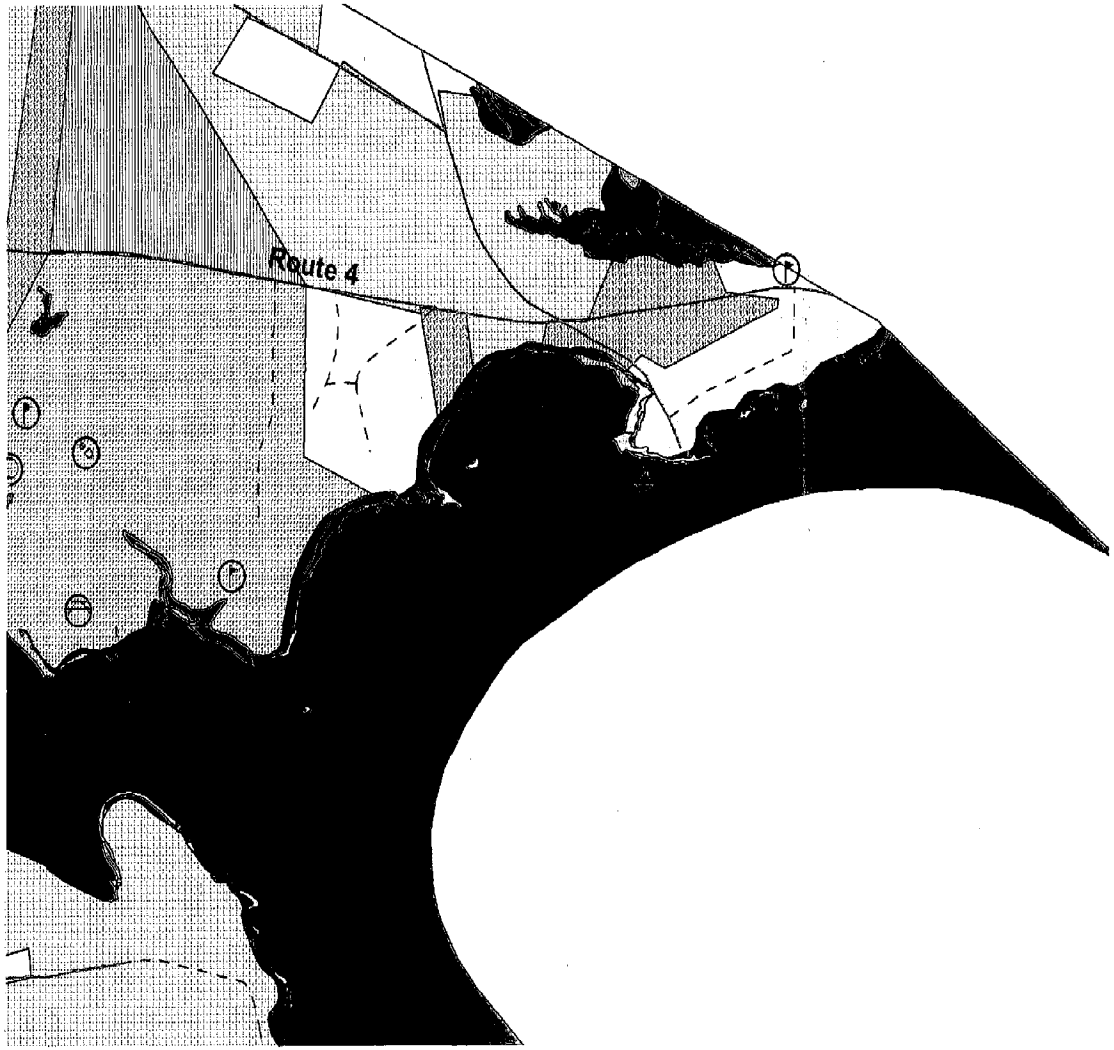
Great Bay Wetland Coverage
- 1 Salt Marsh
- 2 Algae
- 3 Upland
- 4 Water
- 5 Unknown

Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

- Restriction, obstructing flow
- Restriction, not obstructing flow
- Primary Viewing Location
- Picnic Area/Grills
- Recreation Site/Trails
- Potential Recreational Site/Trails
- Public Boat Access
- Potential Educational Site

Coastal Method Systems 3 and 7



Map 5

Great Bay Wetland Coverage
- 1 Salt Marsh
- 2 Algae
- 3 Upland
- 4 Water
- 5 Unknown

Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

- Restriction, obstructing flow
- Restriction, not obstructing flow
- Primary Viewing Location
- Picnic Area/Grills
- Recreation Site/Trails
- Potential Recreational Site/Trails
- Public Boat Access
- Potential Educational Site

N

Coastal Method Systems 9 and 10

N

Map 6

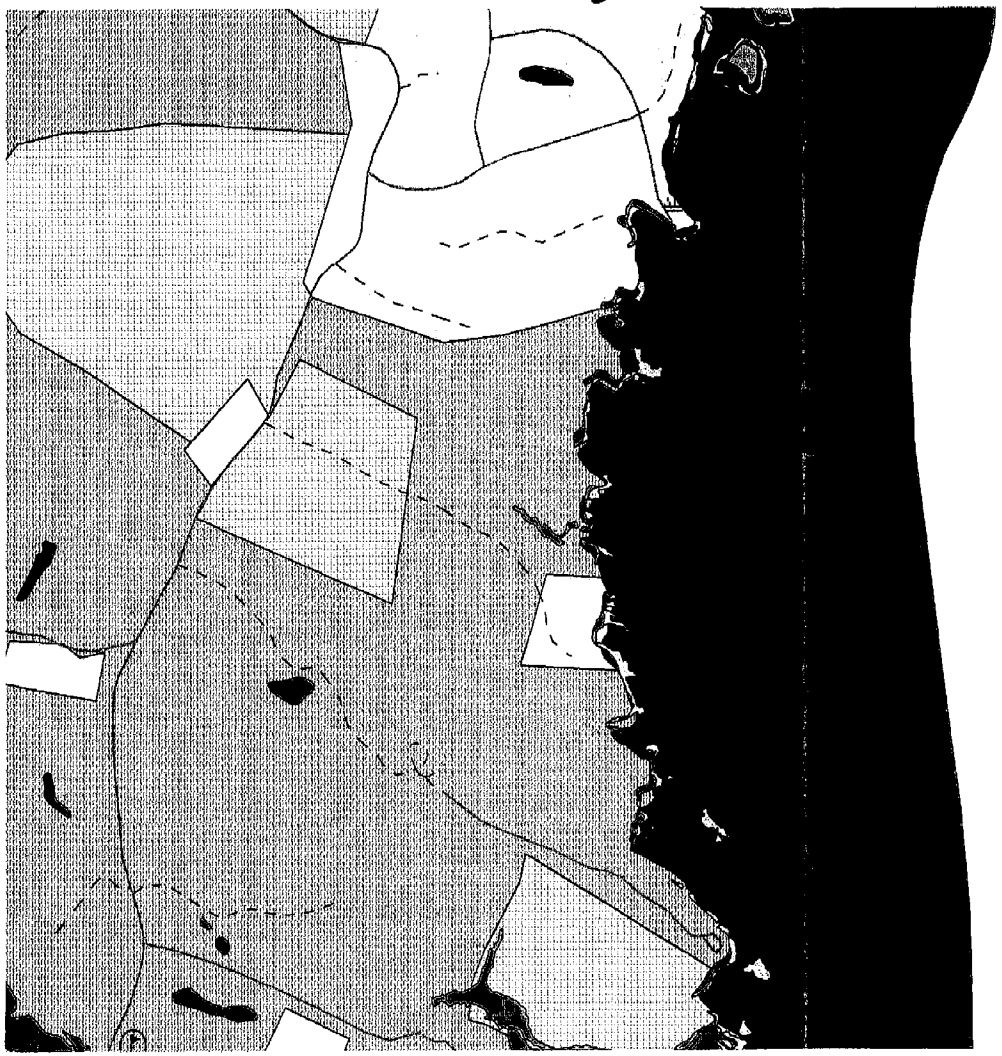
Great Bay Wetland Coverage
- 1 Salt Marsh
- 2 Algae
- 3 Upland
- 4 Water
- 5 Unknown

Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

- Restriction, obstructing flow
- Restriction, not obstructing flow
- Primary Viewing Location
- Picnic Area/Grills
- Recreation Site/Trails
- Potential Recreational Site/Trails
- Public Boat Access
- Potential Educational Site

Coastal Method System 11



Map 7

Great Bay Wetland Coverage
- 1 Salt Marsh
- 2 Algae
- 3 Upland
- 4 Water
- 5 Unknown

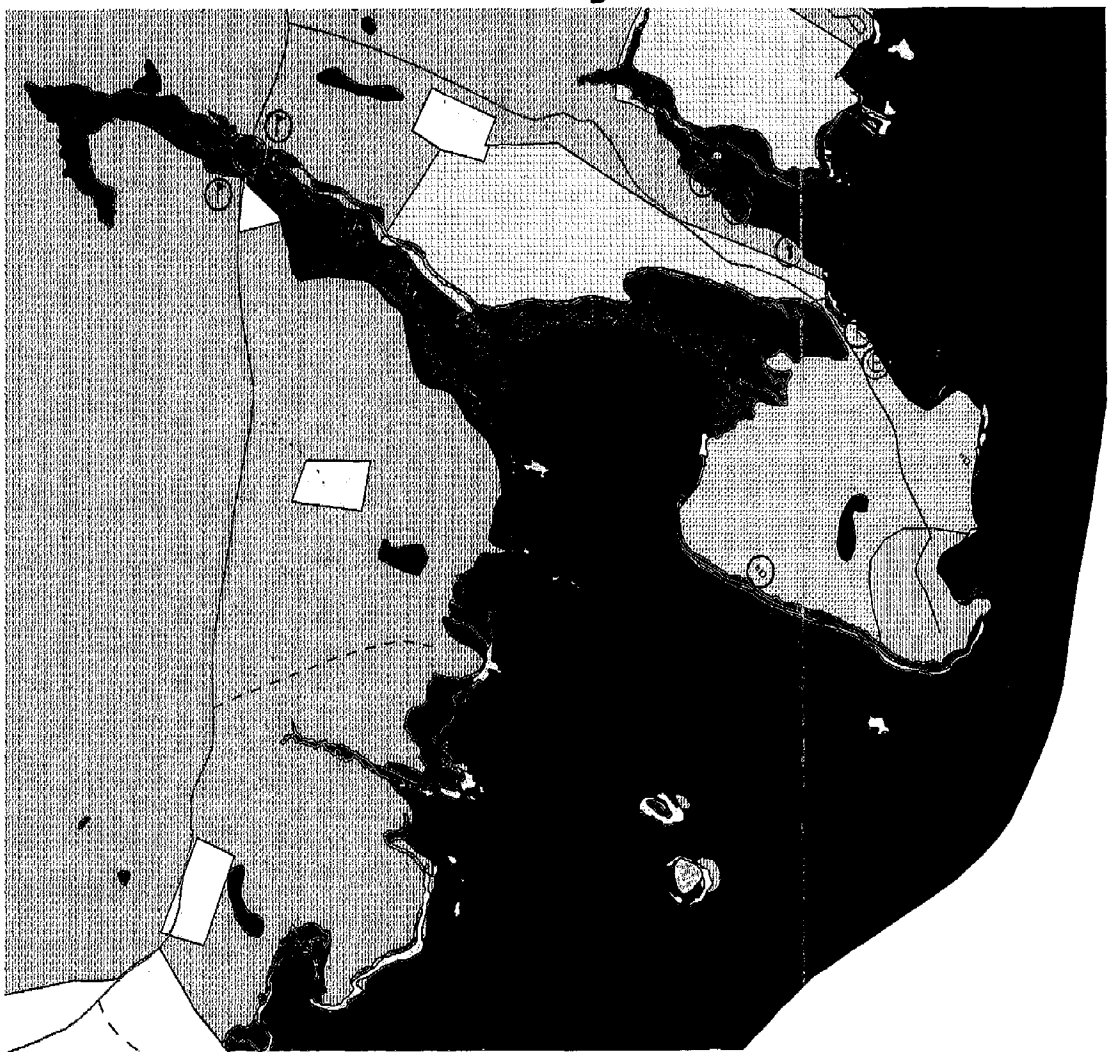
Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

- Restriction, obstructing flow
- Restriction, not obstructing flow
- Primary Viewing Location
- Picnic Area/Grills
- Recreation Site/Trails
- Potential Recreational Site/Trails
- Public Boat Access
- Potential Educational Site

N

Coastal Method Systems 12 and 13



Map 8

Great Bay Wetland Coverage
- 1 Salt Marsh
- 2 Algae
- 3 Upland
- 4 Water
- 5 Unknown

Roads
- Primary
- Secondary
- Road or Street
- Unimproved
- Trail
- Other

Land Use
- Single Family Residential
- Multi-Family Residential
- Mobile Home Park
- Commercial
- Industrial
- Urban Mixed Use
- Developed Institutional
- Public Recreational
- Agriculture
- Open Space / Vacant
- Forest
- Water
- Approved Subdivision

- Restriction, obstructing flow
- Restriction, not obstructing flow
- Primary Viewing Location
- Picnic Area/Grills
- Recreation Site/Trails
- Potential Recreational Site/Trails
- Public Boat Access
- Potential Educational Site

N